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Recovery Is Impeded By the Drive for Reform

BUSINESS in general throughout this country is better than business sentiment, as witness the usually accepted indicators. At the bottom of business sentiment is a state of apprehension over developments in Washington, where the agencies of reform are still in conflict with the forces of recovery. The objectives of reform are laudable in so far as they seek to correct abuses, but in our judgment some of the pending remedies are too drastic and will prove abortive.

For example, the Wagner Labor Relations bill. The stated purpose is "to promote equality of bargaining power between employers and employees, to diminish the causes of labor disputes." We believe the bill, if enacted, would drive a wedge between these two groups, separating them into armed camps, breeding dispute instead of preventing it, and nullifying the excellent labor relations now existing in many industries. The country is badly in need of a sound labor policy, fair to all, but the Wagner bill will not provide it.

Nor is the Black-Connery Thirty-Hour Week bill a sound economic solution of unemployment. Designed to spread employment and wages by arbitrary limitation of working hours, it would inevitably result in diminishing the production of wealth, whereas what we need is not less production but more. It would increase prices of manufactured commodities, curtail consumption, and tend to freeze standards of living at the reduced level. It would defeat the agricultural program and impede revival of foreign trade. Reducing the hours of labor is a desirable end in itself, but it will not promote national welfare if accomplished by legislative fiat. The remedy lies, rather, in the complete substitution of modern equipment for the antiquated and obsolete machinery which now holds down production to the tempo of a past generation and in a thorough rebuilding of the superannuated dwellings and other structures in which the people live and work and play.

The legislative attack on utility holding companies is another example of wholesale reform that lacks discrimination and selection in its objectives. We have no defense or apology for those utility magnates who built unsound corporate structures which, in their collapse, brought loss and ruin to investors. Nor are we convinced that all utility holding companies are equally bad. To condemn all indiscriminately merely increases apprehension and delays execution of their plans for expansion and construction which, as Kennecott's last annual report points out, is of great importance to the copper industry.

Other examples could be cited, all to the effect that the proponents of reform have created a state of apprehension in business by proposing needlessly drastic correctives that should not be enacted into law. These matters are enormously complex and difficult of solution. They call for much more thought than they have received, more conference and conciliation, and much less partisan pleading.

Securities Commission Stops Mining Fraud

CRITICS of the Securities Act have freely charged that piece of legislation with retarding recovery by making it difficult to finance new business ventures. Let's take a look at the other side of the shield, even though the picture is not a pleasant one to contemplate. We shall find some justification for federal control of the issuance of securities, and for protection of prospective investors against fraudulent promoters.

Last month the Securities and Exchange Commission issued an order stopping the effectiveness of the registration statement of the Big Wedge Gold Mining Company of California. The action followed a hearing that revealed a sordid and all too familiar story of dishonesty, one that has given the mining industry a bad name among investors and made difficult the promotion of honest enterprise. The public record is available to those who wish to peruse it.

Briefly, the Securities and Exchange Commission found false and misleading statements and omission of material facts in the registration statement, the financial statements, the prospectus, and even in the engineer's report as to the prospects of the property. The company was insolvent, ore did not exist in the quantity or grade stated, maps were false, no commercial ore had been put through the mill, nor was there sufficient ore in the mine to warrant any kind of a mill. Finally, it was revealed that the consulting engineer who prepared the report filed with the registration statement had said that he had to respect the wishes of his client in making his report. So much for business integrity and professional ethics! In issuing its stop order the commission has rendered a service to the mining industry as well as to prospective investors in mining stocks.

Work-Relief for the Mineral

EDITORIAL STAFF INTERPRETATION

Suggested Types of Relief For Mineral Industry

1. National mineral inventory
2. Economic analysis of mineral requirements
3. Exploratory development of deficiency mineral occurrences
4. Technologic research on metal and non-metallic processing
5. Direct mining by Government of gold and silver
6. Mining of deficiency minerals by Government

Proposals contemplate investigations in Item 1 and part of work in Item 3 be by Geological Survey; the remainder of the work is proposed to be done by Bureau of Mines. Money may be allotted direct or through State agencies.

UNCLE SAM will soon be operating mines under the Work-Relief Act. This seems inevitable, because no alternative plan for quick relief of stranded mining populations appears available. Denials of this policy will emanate from Washington at intervals, but that even officials opposed to it will be pushed into it by midsummer appears certain.

First unquestionably will come operation of submarginal gold and silver properties. These will be worked directly by the Government, under contract or on a subsistence prospector basis, with the Government taking the precious metals produced to increase its monetary reserves. These developments will come first because they offer no direct competition with other producers and cannot affect the price at which commercial miners will sell their gold or silver. But they represent the nose of the camel, and the hump is close behind.

Clearest definition of the trend of this development is found in the Pope bill for development of mineral resources, S.1476, which has been before the Committee on Mines and Mining since January. The bill as reported out in March probably will not be enacted, but legislative approval is not necessary to accomplish every important purpose planned by the Idaho Senator. The President already has both money and authority to do all of those things and is likely to be pushed into action on them.

Several other kinds of work more logical for Government action are being considered. However, all of them together use relatively few people, and therefore give neither adequate reemployment nor wanted industrial pump priming. These scientific and technologic projects will be considered and some aggressively worked. Hence they deserve careful study, even though known not to be the big push for mining relief.

Two sorts of fundamental mineral investigations are contemplated. First is an inventory of the national mineral resources, obviously a job for the United States Geological Survey. The second is an analysis of prospective consumptive need for minerals and metals, a job for the economics branch of the Bureau of Mines. Taken together, these two projects would be the sort of undertaking recommended by the Planning Committee for Mineral Policy. (See *E.&M.J.*, Jan., 1935, p. 12.) They would, of course, give factual basis for fixing future mineral policy.

Two sorts of technologic investigations are also contemplated: one, exploratory development of resource discoveries, a job for mining engineers; and, second, technologic research on improved processes for submarginal minerals, intended to develop methods feasible for working them either now or in time of emergency. These latter studies are, of course, primarily jobs for the ore dresser, metallurgist, and chemical engineer.

Whether there are unemployed in the United States more than a few persons who could usefully be employed on some of these undertakings is questionable, even though time and appropriations were not a matter of concern. However, they represent fundamental work of greater importance to the minerals industries than any amount of quick spending or immediate relief which Uncle Sam can undertake.

At no time in the history of the United States has the United States Geological Survey ever had funds or definite instructions to make a national inventory. Tremendous masses of detailed information are available, some coordinated by areas, some partly brought together by commodities, but at no time have either the areal or mineral inquiries been consolidated into a properly indexed, properly coordinated set of facts, stating what, where, and how much our mineral resources are.

Typical methods of the U.S.G.S. could be used for such an inventory. Field work would be by parties and groups of parties under skilled geologists, each covering territory thoroughly with respect to all minerals observable. The bottle neck of this project is the number of men skilled in geological exploration available for engagement by the Government. Washington guesses that not more than 25 or 50 men competent to be independent heads of parties of this sort could be engaged at the present time. But of course each such experienced leader would have several professional coworkers and an appropriate staff of manual aids, campers, cooks, and the like. All together, for the next two years when this work would be done, not more than a couple of thousand investigators could be put at this field task. The added number for office and service purposes would not greatly augment the total. This kind of a job is primarily a white-collar relief project in so far as it tends to give new employment. Money from the $300,000,000 earmarked fund for this type of relief will be had if the President becomes convinced of the worth and the feasibility of such assignment. Merely as a guess, one might anticipate that a million dollars a year is the right order of magnitude to anticipate as the assignment for this mineral-inventory project.

Estimate of Needs

We have still less information regarding consumption and prospective needs for mineral products than we have as to the resources available. Fortunately, however, trade, technical, and official sources of data can be drawn on as starting information from which to develop a fair picture of America's mineral requirements under a variety of reasonable assumptions. This kind of job, if undertaken, will undoubtedly be assigned to the economics branch of the Bureau of Mines. There it would represent an outstanding new effort, but would not require any new sort of general management nor any technique

strikingly different from that already applied by the Bureau specialists.

To undertake such a study with a view to comprehensive treatment of all important minerals within a biennium would require about as much money for the Bureau as is estimated in the foregoing as suitable for the mineral inventory by the U.S.G.S. It is obvious, therefore, that this project too, though of immense economic value to the mineral industries, is hampered severely because it is not of pump-priming magnitude. It needs several more ciphers at the left of the decimal point to make it visible in Washington atmosphere of billions. If the mineral industry pushes hard enough, such a project can probably be undertaken. It is perfectly evident that the Bureau both could and would be glad to do the work. There remains, therefore, only the task, and no small one, of convincing the President of the reasonableness and appropriateness for immediate attention.

Deficiency of Minerals

A variety of proposals have been made as to how far work-relief should be carried in actual mineral production. None of these projects can get very far without bringing in practical conditions in industry which will be at least indirectly competitive with present mining enterprise. The proposals that only deficiency metals and minerals be handled is a feeble barrier against such competitive consequence. The mining industries can count on real problems of large importance in some fields, possibly even with respect to commodities for which America has an abundance or even a surplus. There is, however, less difference of opinion as to whether the Government should go ahead on exploratory development of certain resources that have been identified. Hence it seems almost certain, for example, that much will be done in the way of core drilling, shaft sinking, and even actual blocking out of minerals. The Government has already a precedent-making example as to how such effort works in the case of core drilling for potash in the Southwest. The great success attained in that project gives present impetus to the proposal that like explorations be made with respect to every other deficiency mineral. Should such authority be given the projects are likely to be handled jointly by U.S.G.S. and the Bureau of Mines, just as the potash drilling was done by the Bureau with the direction as to sites from the Survey.

An almost indefinite amount of work of this type could be carried out. Hence even as much as $5,000,000 per year might be so applied without waste. However, there is at the time of writing (late April) no evidence as to whether a sum of that magnitude would attract sufficient political and industrial support to gain Presidential approval.

Among the minerals that are to be considered for such developmental exploration are seven metals and approximately an equal number of non-metallics. These are the major strategic minerals frequently discussed in the pages of *E.&M.J.* (See, particularly, the article by R. S. McBride, *E.&M.J.*, Jan., 1935.) The seven metals now in contemplation in Washington are antimony, chromium, manganese, nickel, quicksilver, tin, and tungsten. The non-metallics are primarily mica and graphite, with secondary prospects for asbestos, barite, china clay, magnesite, and talc or soapstone.

A second class of engineering investigation which may be authorized to the extent of possibly three to five million per year is the technologic development of processes to convert submarginal resources into workable supplies. Among the problems would be, for example, the developing of new methods of ore dressing, modified smelting procedures, and new types of utilization technology which would permit American minerals to be used with technical success in case of need. The Bureau of Mines, which would be likely to be in charge of this work, hopes that some new processes might even convert what are now submarginal deposits into economically profitable mineral supplies.

Some of the current work on the processing of polyhalite is an example of the type of undertaking which is proposed. New processes for beneficiation of low-grade manganese ore could also be further studied. (The Bureau of Mines already has spent some hundreds of thousands of dollars in a five-year program without yet giving a final economic answer.)

In this set of projects industry might find competitive threat as well as prospective aid. Bitter controversy on the score of expediency is, therefore, anticipated. Among the arguments of the proponents of this plan one notes most importantly the following:

1. The United States should know how to be self-sufficient in an emergency, regardless of the cost of doing so.
2. Available technology to permit self-sufficiency with respect to minerals makes United States neutrality much easier in the event of either a European or an Asiatic conflict of large size.
3. New processing of this sort will be a stimulus to commercial work of present industry. And the more conservative proponents add that, properly managed, the Government investigations will aid and not compete with private business.
4. Such operation for the better development of American resources now submarginal would provide for peacetime advantage, notably in the case of deficiency minerals, placing a ceiling on the price which foreign monopoly might charge if America were wholly dependent on foreign resources.

Money Allotments

It may be midsummer before even the most attractive of the projects outlined in the foregoing can make definite progress. Even then some of them, such as the mineral inventory, may have to be done in part in cooperation with State agencies, even though that admittedly will be a less efficient plan. Expediency may so dictate, for Congress has shown strong evidence of resentment that some previous P.W.A. funds were used to expand activities of regular Government agencies which Congress had been unwilling to support with direct appropriations.

Should the Pope bill advance further on its legislative course and give evidence of prospective enactment, this would accelerate greatly the plans for allotting relief funds to the Bureau of Mines for direct mine operation. The bill as it now stands on the Senate calendar would so allot $100,000,000 as a revolving fund. This money would be spent in all manner of work, including actual mining, smelting, and refining, limited only by the declared purpose of Congress.

As already stated, there seems no escape from the fact that extreme pressure will be put on the President to utilize these measures for relief of stranded mining populations. And it is evident from many recent events that the President when so pushed is likely to yield, lest more radical extremes be forced on him by Congress. Despite the clearly apparent trend, forecasting either the scope or the speed of these developments is, of course, very difficult.

Major Strategic Minerals

for which intensive exploration and development should be carried on in the United States

METALS	NON-METALS
Antimony	Mica
Chromium	Graphite
Manganese	Asbestos
Nickel	Barite
Quicksilver	China clay
Tin	Magnesite
Tungsten	Talc

Big Canyon's Surface Plant

An Instance of Modern Efficient Design

John B. Huttl
Assistant Editor
San Francisco, Calif.

● 75-FT. STEEL HEADFRAME and its built-in receiving bin, delivering to the crushing plants. In the foreground at the right is the hoist building which also houses the power equipment

RECOGNIZING that one of the most important factors in the economical operation of a mining property is a surface plant that will handle the mine output at the lowest possible cost, the Mountain Copper Company, Ltd., in planning the surface installation at its Big Canyon mine, about 4½ miles south of Shingle Springs, Eldorado County, Calif., gave particular attention to its design and to the equipment selected, as well as to the future upkeep of the latter and to safety considerations. The plant, laid out on a gentle slope and completed late in December, 1934, is an outstanding example of modern design, made possible by a liberal and intelligent expenditure of money. Several units are almost entirely automatic in operation, and use is made of overhead cranes and trolleys throughout the plant to facilitate repairs and replacements. Another novel feature that excites the interest of the visitor is the application of the mezzanine-floor system of construction at the crushing plants and mill. Here all machinery, drive and feed mechanisms, and auxiliaries are placed below a sectionalized floor supported by steel columns, this affording safety to the operator and accessibility to the equipment, and keeping the operating platform free from dust and dampness.

All buildings are steel-frame structures covered with galvanized iron, and ample allowance has been made for expansion should this be necessary at a later date. Plant capacity is about 300 tons per day. Inasmuch as we hope to present a more informing discussion of mining and milling operations later on, both subjects will be touched upon in this article only in a somewhat sketchy manner.

The history of the Big Canyon mine is interesting. Discovered in 1885 when surface formations were hydraulicked, the property was worked spasmodically on a modest scale until it was purchased in 1892 by Hayward and Lane, who successfully operated a 30-stamp mill for years.

The orebody is a siliceous replacement in amphibolite schist with serpentine hanging wall, and the pay shoot, exceeding 400 ft. in length, has been worked in large open stopes. When finally shut down in 1901 the mine had been developed by an incline shaft to a depth of 750 ft. The present owners acquired the property early in 1934, following a comprehensive sampling and diamond-drilling campaign. Active rehabilitation started on May 16, 1934, and the plant went into operation on Jan. 1, 1935. Erection of steelwork began on July 2, mining on July 24, and the new 45-deg., three-compartment incline shaft was started on Oct. 1, 1934. This shaft is now bottomed 362 ft. below the concrete collar, and each compartment measures 5 ft. 1 in. by 5 ft. 2 in. inside the timbers.

Four-Ton Skips Used

Hoisting of ore is done in 4-ton skips fitted with double-tread rear wheels operating in two compartments. A 1-ton skip in the third compartment is used for sinking and handling materials and tools. The ore skips are operated at a speed of 500 ft. per minute over 40-lb. rails spaced 42 in. The 75-ft. steel headframe is equipped for dumping automatically into an 18x24-ft. steel receiving bin with a 30 deg. cone bottom, from which a 40 deg. incline chute measuring 50x50 in. discharges over a manganese grizzly into the primary crusher. The third shaft compartment is fitted with 40-lb. rails spaced 24 in., and an automatic dump has been arranged at the No. 1 level for discharging waste into a pocket just above that level during sinking. An additional small waste bin and dump eventually will be installed at the top.

Hoist House Well Equipped

Power and hoisting facilities are housed in one building. This contains a double-drum Nordberg hoist driven by 165-hp. G.E. motor; an auxiliary hoist powered by a 52-hp. motor; two I-R air compressors, one an Imperial Type 10, of 1,300 cu.ft. capacity, and the other of 1,500 cu.ft. capacity, both being equipped with short-center drives and driven by a Westinghouse 200-hp., 2,300-volt, induction motor and a Westinghouse 290-hp., 2,300-volt synchronous motor respectively; and the main switch board, which receives power for the mine and plant at 2,300 volts from three Pacific Gas & Electric Company 500-kva., 66,000- to 2,300-volt transformers of the outdoor type. The main hoist has a magnetic controller, both primary and secondary with a grid rheostat, and safety signals placed below the collar of the shaft; also an emergency oil switch remotely controlled from the operating platform. On this stand also are situated a telephone, all necessary light and signal system switches, and the emergency switches for tripping out the compressors.

The signal system used in the shaft is a six-wire installation, using two hot wires at 110 volts a.c., a switch wire

for each of the three shaft compartments and one for the buzzer. Skips are called by the buzzer signal and operated on the bell signal of the respective compartments. Mine signal switches are installed at each level in addition to the bell cords running between levels. To facilitate operation and trouble shooting on the system, the cable is of the coded seven-wire type, and signal boxes are available at each station. These contain mounted switches to disconnect either the station or the line extending to the next station. The auxiliary hoist is controlled manually. Provisions are also made in the shaft for electric blasting.

The main switchboard is a seven-panel slate board, on which are mounted a voltmeter, the power company's meter, oil switches, ammeters, and wattmeters of each circuit. This arrangement facilitates correct supervision and allocation of power costs. Transformer equipment consists of a bank of three 100-kva., 2,300- to 440-volt transformers just behind the power house, a duplicate bank near the mill, a bank of three 10-kva., 2,300- to 220/110-volt at the machine shop, and several small units for local and lighting loads. All large motors operate at 2,300 volts.

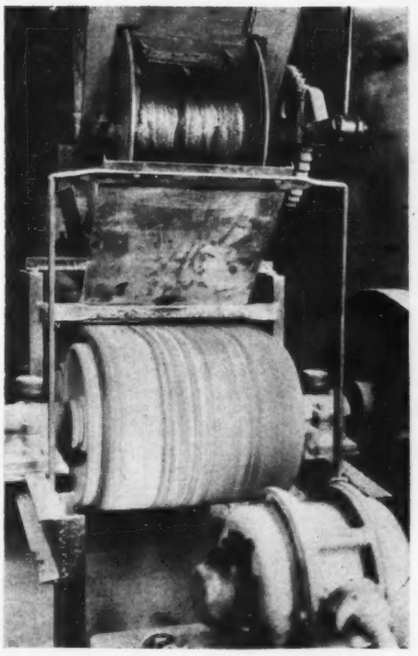
Mountain Copper Company's gold mining enterprise at Shingle Springs, California, shows the result of liberal and intelligent investment . . . Features include automatic control of units, liberal use of cranes and trolleys, and a mezzanine type of construction in the crushing plant and mill that affords safety to employees, easy access to equipment, and clean, dry operating conditions

Crushers and Conveyors Interlocked

Adjoining the headframe is the 24x20-ft. primary crusher building. It has the sectionalized mezzanine operating floor previously mentioned and contains an Allis-Chalmers 24x36-in. jaw crusher driven by a 100-hp. G.E. induction motor through a short-center V-belt drive. Oversize from the manganese-steel grizzly below the chute of the receiving bin is fed by a Ross chain feeder to the jaw crusher, which is set to produce a 3-in. product. The chain feeder is actuated by a Reeves variable-speed drive. The undersize drops into a special feed chute, as shown in the accompanying line drawing, whence it is fed gently onto a 24-in. belt conveyor leading to the secondary crushing plant. This conveyor measures 65 ft. between centers and is driven by a 7½-hp. Pacific Gear & Tool speed-reducer unit attached to the head pulley. Maximum incline is 14 deg. Tramp iron and drill steel are removed by a 24-in. Cutler-Hammer magnet suspended from a crane arm just ahead of the feed chute.

The secondary crusher building is identical in size and layout with the primary building. It also is provided with overhead I-beam crawls, extending beyond its walls, to facilitate replacement and removal of worn parts. Crushing equipment consists of a 4-ft. Symons cone crusher driven by a 100-hp. G.E. induction motor through a V-belt drive, which reduces the jaw crusher product to about ⅝ in. The coarse bowl now used in the cone crusher is to be replaced with a fine bowl to crush to ⅜ in. Crushed product is fed through a chute onto a 20-in. belt conveyor, measuring 250 ft. between centers and mounted upon an incline steel trestle, which discharges into the mill bin. Belt speed is 150 ft. per minute. The drive mechanism, powered by a 15-hp. Pacific Gear & Tool speed-reducer unit with a magnetic brake, is in a steel tower situated in the center of the incline trestle.

All crushing and conveying machinery, including the Ross chain feeder, is electrically interlocked so that no part of the plant may be operated or will continue to operate unless the machine next in line is working. The entire plant can be controlled from either the jaw-crusher building or the cone-crusher building. Inasmuch as the operator is usually in the jaw-crusher building, the all-metal-clad switchboard installed there also contains an ammeter for the cone crusher, which enables the operator to watch the running of this equipment at all times. Because of the extensive layout of the crushing plants and mill which makes constant inspection of the machinery difficult, a buzzer signal system has been installed that can be operated at strategic points in the crushing plants, mill, and mill superintendent's office for call and warning use.



• **THIS DRUM-TYPE FEEDER and its companion Hardinge Constant Weight feeder discharge the contents of the fine-ore bin in two separate streams onto a 22-in. belt conveyor. One of these streams is scraped off into the feed box of ball mill No. 1. The other is delivered direct to mill No. 2**

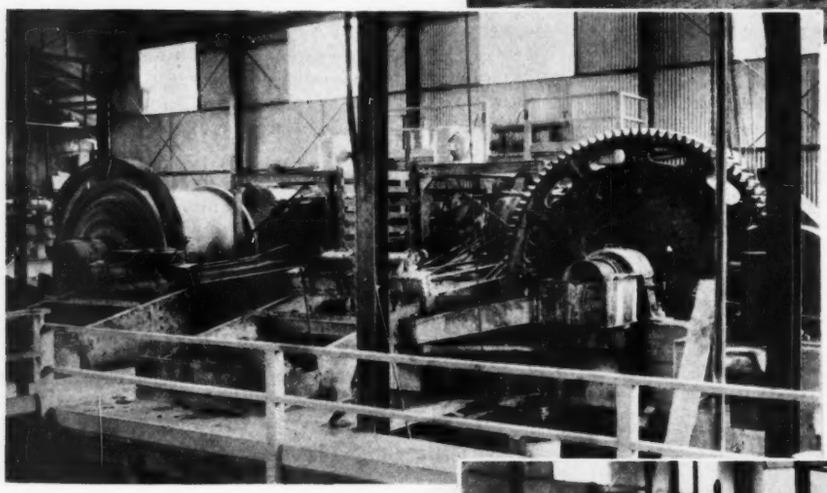
Fine Grinding and Concentration in Separate Building

Like all the other plant structures, the 300-ton mill is a fireproof, all-steel building. It houses the fine-grinding, flotation and filtering equipment and auxiliaries. Save for a few minor operating details, its flowsheet is practically identical with that of the newer flotation plants on the Mother Lode and in the Grass Valley area. The ore sent to the mill is a hard, abrasive, silicified amphibolite schist, assaying about 3 dwt. in gold. Free gold constitutes about 20 per cent of the values contained, the remainder being combined with pyrite and pyrrhotite. Ratio of concentration is about 14.2 to 1, the concentrates produced running from 40 to 50 dwt. Ore production exceeds 9,000 tons per month.

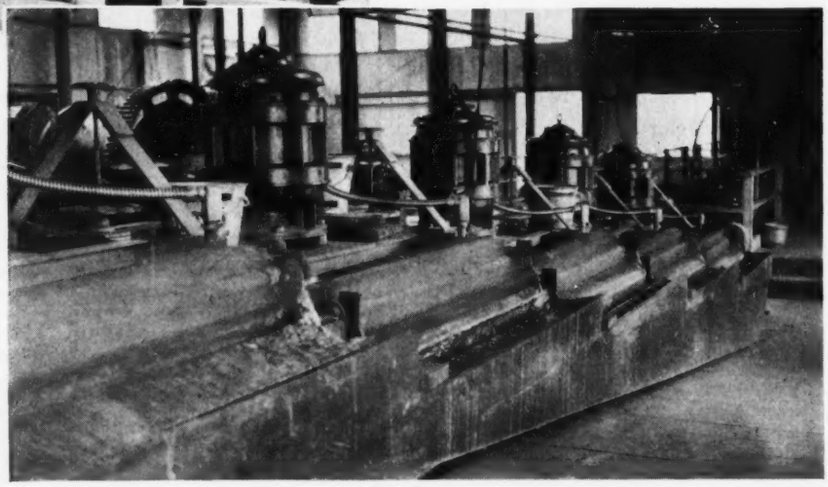
Adjoining the mill building is the steel fine-ore bin. It is 24 ft. in diameter and 30 ft. high, and rests upon a concrete foundation with an arched subway, in which is installed the belt conveyor leading to the ball mills. From the flat bottom of the bin, the crushed ore is drawn through two spaced openings equipped with automatic feeders. One is

● **AT BIG CANYON MINE** of the Mountain Copper Company near Shingle Springs, in Eldorado County, Calif. The steel headframe is 75 ft. high and serves a 45-deg. incline shaft. A skip is seen dumping into steel receiving bin, behind which is the primary crushing plant. The secondary crushing plant is at the left. From it the incline conveyor in the foreground leads to the fine-grinding and concentration department

● **CONCENTRATION BY FLOTATION** and the fine grinding that precedes it are done in this building. Capacity is 300 tons per day. At the right is the 24x10-ft. Dorr thickener which prepares the flotation concentrate for filtration and delivers it from the bottom of the tank to an Oliver filter, inside the building. The filtered concentrates are then elevated by conveyor to the concentrate loading bin in front of the mill



● **THE FINE-GRINDING SECTION** of the 300-ton mill. Both No. 1 and No. 2 ball mills are of Allis-Chalmers make, and are 7 ft. in diameter and 6 ft. long. Each mill has a $\frac{4}{8}$-in. grating and works in closed circuit with a 6x21½-ft. double-rake Dorr classifier. The two mills are driven each by a 150-hp. motor, one through a short-center belt drive and the other with a Link-Belt chain



● **CLASSIFIER OVERFLOW**, after being conditioned for two hours, goes to this five-cell, 56-in. Fagergren flotation machine, which is equipped with dual skimmers that are driven by a small Stirling speed reducer unit. Concentrates from any cell may go direct to the sump, and the middling from the remaining cells may go to the 36-in. Fagergren machine

a Hardinge Constant Weight feeder and the other a regular drum-type feeder. Both are adjusted to discharge the mill feed onto the 22-in. belt conveyor in two separate streams, the division of which is adjustable. The conveyor is 80 ft. long between centers and is driven by a Pacific Gear & Tool 5-hp. speed-reducer unit connected to the tail pulley of the conveyor. One ore stream on the conveyor is scraped into the feed box of ball mill No. 1 by a special rubber scraper; the other stream goes direct to ball mill No. 2. The mills are of Allis-Chalmers make, measure 7 ft. in diameter and 6 ft. long, employ $\frac{5}{16}$-in. grates, and operate in closed circuit with two 6x21½-ft. double-rake Dorr classifiers. Both are driven by 150-hp. motors, one through a short-center belt drive and the other with a Link-Belt chain. The classifiers are actuated by 5-hp. Stirling variable-speed units. The discharge bowls overhang the classifier foundations so as to make it easier to clean out the machines. Experiments are being conducted with a Denver Equipment unit cell and Booth-Thompson hydraulic traps interposed between ball mill No. 1 and classifier No. 1 and ball mill No. 2 and classifier No. 2 respectively, for the removal of free gold from the grinding circuit.

The 60-mesh classifier overflow goes via discharge launders to a two-compartment steel sump, to each compartment of which is connected the suction pipe of a 4-in. Wilfley pump (one standby unit). These pumps raise the pulp vertically to an elevation just under the roof of the mill building, whence it flows to a 16x11-ft. conditioner tank employing a Dorr agitator operating at about 1 r.p.m. Special connections are available in the 4-in. pipe line feeding this tank to send the classifier overflow direct to the flotation machine should this be desired. The pulp remains in the tank about two hours. When conditioned, it goes with any excess overflow in separate pipe lines to the head of the flotation machine. Thus the conditioner tank is also made to serve as a surge tank.

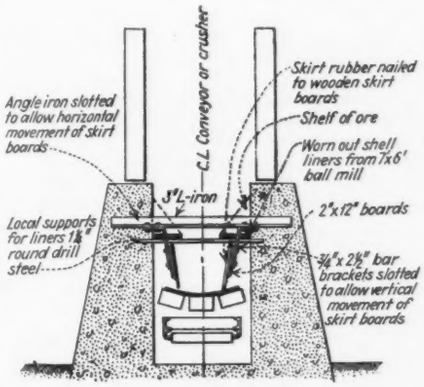
Fagergren Flotation Machines Used

Flotation equipment consists of a five-cell, 56-in. Fagergren flotation machine equipped with dual skimmers driven by a small Stirling speed reducer unit. Concentrates from any cell may flow direct to the pump sump, and the middling from the remaining cells may go to a 36-in. Fagergren cleaner machine. Cleaner tailing returns to the two-compartment sump to which the classifier overflow goes, and the concentrates flow to the pump sump in which the concentrates from the rougher machine collect. The rougher tailings can be passed either over a Plat-O pilot table or a twin launder fitted with corduroy cloth and installed directly under the rougher machine to recover fine gold that may be present in the tailings. Sampling is done by an automatic Geary-Jennings sampler. Final tailings flow by gravity in a wooden flume to the tailings pond.

The bucket-type reagent feeders are installed on an elevated platform near the rougher machine. All are connected to a main drive shaft actuated by a Stirling variable-speed unit by short chain drives. A small, motor-driven Manzel positive feeder is available at the third cell of the rougher machine. All launders and sumps are made from ⅛-in. steel plate, electrically welded in place.

Treatment of Concentrates

Concentrates collected in the steel sump are pumped vertically to a point just under the roof of the mill building by a Wilfley sand pump, whence they flow by gravity to a 24x10-ft. Dorr thickener. The filter product, discharged at the bottom of the tank, flows


Angle iron slotted to allow horizontal movement of skirt boards
C.L Conveyor or crusher
Skirt rubber nailed to wooden skirt boards
Shelf of ore
Worn out shell liners from 7x6' ball mill
3"L-iron
2"x12" boards
Local supports for liners 1¼" round drill steel
¾"x2½" bar brackets slotted to allow vertical movement of skirt boards

● MINE ORE from the receiving bin at the shaft passes through a chute and over a grizzly, the oversize going to the primary jaw crusher and the undersize through a special feed chute, shown here in cross-section, onto a conveyor serving the secondary crushing plant

by gravity to a 11½x6-ft. Oliver filter. Filter cake falls upon a 16-in. belt conveyor, 60 ft. long, leading to two elevated steel bottom-drop bunkers mounted on a wooden trestle under which trucks are run and loaded. The concentrates are trucked to Stockton, and thence go by boat to the American Smelting & Refining Company's smelter at Tacoma. A 4-in. diaphragm pump is used to circulate heavy concentrate in the thickener tank when necessary.

Electrical Control Facilitates Operation by One Man and Helper

Save for the two 150-hp. motors driving the ball mills, all motors at the mill operate on 440 volts. The main switchboard is an all-steel panel situated on the mezzanine floor in the center of the mill, and contains the circuit breakers and magnetic switches for the 440-volt motors operating in the mill. The motors driving the Oliver filter auxiliaries are controlled only from their respective positions. To facilitate control of the grinding section, the ball-mill feeders, conveyors, and classifiers can be started with pushbuttons installed adjacent to the 2,300-volt starting equipment on the ball-mill motors. The feeder conveyor and the constant-weight feeder are electrically interlocked. Ammeters on the ball mills keep the operator in constant touch with grinding conditions, and the arrangement of the electrical control equipment—all meters and switches are in view of the operator from the center of the mill—makes it possible for one man and a roustabout to operate the entire mill.

As the drives on the thickener tank and on the conditioner tank are outside the mill, signal lights are mounted on the mill switchboard to indicate any change in operation. Another signal device installed on the switchboard panel indicates any overflow at the two-compartment pulp sump. Perhaps the most notable feature of the power end of the entire plant is the absence of fuses. All circuits are opened and closed through three-pole switches and circuit breakers, thus insuring a correct three-phase power distribution.

Plant and Shop Equipment

Other plant buildings include a steam-heated modern change house, a laboratory containing equipment for metallurgical research and dry and wet assaying, repair shops, and a general office. The machine shop is well equipped with tools and metal-working machines, such as lathes, planers, drill presses, and others, and the electrical repair shop contains devices and tools for testing and rewinding motors. Two I-R drill sharpeners and an oil forge are available at the drill-sharpening shop.

Water for operations is obtained from Big Canyon Creek dam, which impounds about 200 acre-feet of water. It is earth-filled, 60 ft. high and 440 ft. long along the crest, and is situated about one mile north of the plant. The water flows to a 100,000-gal. steel storage tank through an all-welded 6-in. steel pipe, to which is attached an automatically controlled centrifugal booster pump driven by a 25-hp. motor. All power and pipe lines are laid out north and south and east and west, and sanitary drinking fountains are available at each building, in the yard, and underground.

To W. F. Kett, general manager of the Mountain Copper Company, Ltd., I am indebted for permission to visit the Big Canyon mine and to prepare this account. The information here presented was supplied by J. M. Basham, P. Ransom, and A. W. Hackwood, general superintendent, master mechanic, and mill superintendent, respectively, of the Big Canyon subsidiary.

Shaft Hoisting Capacity Increased By Combination Cage and Skip

Tonnage to be further boosted by cutting dead load by substitution of aluminum for steel

W. S. Maguire

Superintendent
Sylvanite Gold Mines, Ltd.,
Kirkland Lake, Ont.

COMBINATION cage and skip units, shown in the accompanying drawing, which the Sylvanite Gold Mines, Ltd., of Kirkland Lake, Ont., installed in the two hoisting compartments of its main shaft in June, 1933, have proved highly satisfactory and have facilitated mining operations, which now extend to the 3,600-ft. level, the lowest served by the shaft. The mine levels are spaced 125 ft. apart from surface to 3,000 ft., and 150 ft. apart from 3,000 to 3,600 ft., all being kept available for working. The two units hoist the total tonnage of ore and waste, averaging 520 daily, and in addition handle all men and supplies. When used in counterbalance for hoisting on a straight mucking shift, in which no servicing is included, they can raise 350 tons in eight hours. The hoisting is done from several levels, the average lift being 1,500 ft. Rope speed is 1,500 ft. per minute.

Before these cage and skip units were installed, hoisting of ore and waste was done in 1-ton end-dump cars in single-deck cages. The average capacity of the shaft was then 375 tons of ore and waste per day, plus the servicing. Cars were caged from underground stations floored with plates or provided with tracks. When the need for better hoisting facilities became apparent, due to the greater amount of work at depth and an increase in mill tonnage, consideration was given to double-deck cages hoisting two 1-ton cars at a time. The shaft, however, was not equipped with loading pockets or continuous ore passes, and the time and expense of putting them in to serve the levels was prohibitive. Moreover, the objectionable features of loading and unloading cars on double-deck cages were manifest. The combination cage and skip was therefore designed to obtain the advantages of skip hoisting, using the underground layouts as they existed, and at the same time permit servicing the mine at any period of the shift.

The unit is so designed that the skip may be loaded from either the front or back end of the cage, depending on the side of the shaft the underground loading station is on. Where the stations are double, the skip may be loaded more quickly by dumping a car from each side at approximately the same time. When loading is being done, the doors of the cage back and front are folded back in the open position. The floor doors are raised, and the dumping blocks are placed front and back. The blocks are held rigidly between the open floor door and a small clip bolted to the 2x2½x¼-in. side stiffener angles. They are left on the cage while ore is being hoisted, being removed only when the cage is handling men and supplies. The rock hoisted is run-of-mine up to 24 in. in size.

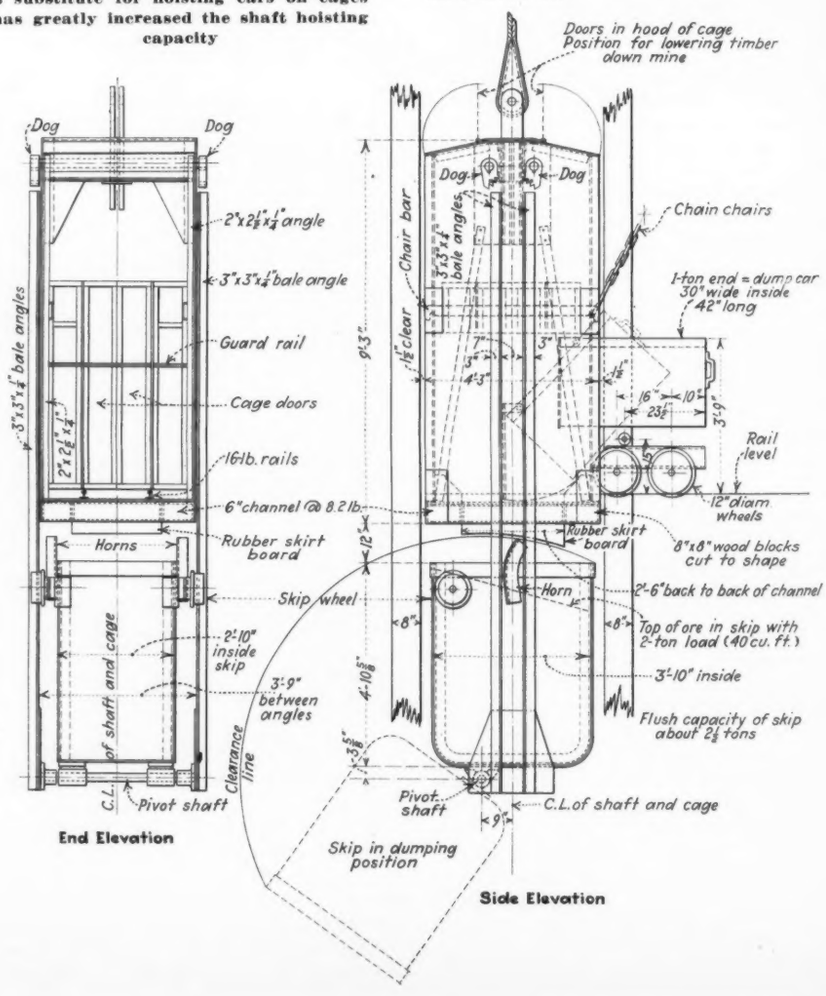
The car door acts as a baffle to prevent a surge of rock spilling over the opposite end of the cage. Due to this and to the small opening in the bottom of the cage, the close spacing of the skip to the bottom of the cage, the rubber skirt around the floor opening, and the overcapacity of the skip, spillage does not occur. This point is essential, as the shaft timbers are not flush-lined and stations are not screened.

When loading, the cage is chaired on chain chairs, with cage and station rail points flush. These chairs detach themselves when the cage is raised.

The general arrangement was designed by myself and was approved by C. E. Rodgers, general manager. Mechanical features of the cage and skip were developed by William Dunn. The units were manufactured by E. Long, Ltd., Orillia, Ont.

Anticipating the time when the company will have to hoist an increased tonnage from a greater average depth, it has recently placed an order for three units identical in type of construction with the ones shown in the drawing, but manufactured chiefly of aluminum, and having a skip capacity of 3 tons in place of 2 tons, as at present. Space occupied by broken ore is estimated at 20 cu.ft. per ton. These 3-ton aluminum units will have a weight of 5,200 lb. each, as against 6,800 lb. for the 2-ton all-steel units.

General arrangement of combination skip and cage in service in the shaft of Sylvanite Gold Mines, Ltd., Kirkland Lake, Ont. The adoption of this idea as a substitute for hoisting cars on cages has greatly increased the shaft hoisting capacity



Fatty Acid and Soap Flotation

Applied to Oxidized Copper Ore

Tests made with malachite afford an explanation of certain collection and frothing phenomena noted when using some of the reagents

Maurice Rey

Professor of Non-ferrous Metallurgy, University of Liége, Belgium

IN A STUDY of the flotation of oxidized copper ores, I investigated the use of oleic, palmitic, and stearic acids, and of various mixtures of fatty acids and soaps. Oleic acid is the most widely used of fatty acids, because it is cheap and because it is liquid at room temperature. The melting point is 14 deg. C. It has the formula $C_{18}H_{34}O_2$ and is an unsaturated acid containing one double bond in the molecule.

Palmitic acid ($C_{16}H_{32}O_2$) and stearic acid ($C_{18}H_{36}O_2$) are saturated fatty acids containing no double bonds. They melt at 63.4 deg. C and 69.3 deg. C and can be used as collectors only when the pulp temperature is maintained in the neighborhood of or above their melting point.

The mixtures of fatty acids investigated were those of palm oil where oleic and palmitic acids are present in about equal amounts and those of maize oil and linseed oil containing, besides oleic, linoleic ($C_{18}H_{32}O_2$) and linolenic acids ($C_{18}H_{30}O_2$) with two and three double bonds.

I found, when using these fatty acids in a pulp made alkaline with sodium carbonate, as is normally the case, that the saturated fatty acids had a strong collecting power but no frothing power at all. They even cut down to a certain extent the frothing power of the other fatty acids present. Oleic acid showed both collecting and frothing power, and the mixtures of unsaturated acids had a strong frothing power, increasing with the degree of unsaturation of the acids present. The best results were obtained with mixtures containing a certain proportion of saturated and unsaturated fatty acids. Mixtures with too strong a frothing power gave low-grade concentrates.

These findings are in accord with Katanga flotation practice, which makes use of a mixture of palm oil and oleic acid for the flotation of malachite.

When the soaps were used instead of the fatty acids, they reacted in a way entirely similar. Sodium palmitate and stearate gave no froth unless flotation was carried out immediately after the addition of the soap or unless a substantial excess was used. Sodium oleate gave a froth similar to that of oleic acid, and various soap mixtures showed a frothing power similar to that of the corresponding acids.

The non-frothing character of saturated fatty acids and soaps described in the foregoing appears strange when it is remembered that, in water, sodium palmitate, and to a lesser extent sodium stearate, are strong frothing agents comparable with sodium oleate. Sodium palmitate was used as a combined collecting and frothing agent for the flotation of apatite by Luyken and Bierbrauer (*Metall und Erz.*, 1929. Heft 8, p. 197. Also "Die Flotation in Theorie und Praxis." Berlin. Julius Springer, 1931, p. 33-34).

To clear up this point, a series of small-scale tests was made with pure malachite. The sample was obtained through the courtesy of Union Minière du Haut-Katanga. Various amounts of oleic and palmitic acid were added to 20 grams of malachite, minus-65 plus-200 mesh, suspended in 125 c.c. of a solution of 0.5 gram per liter of sodium carbonate. The tests with oleic acid were run at 30 deg. C.; the tests with palmitic at 65 deg. C. In every case, after about two minutes of agitation with a high-speed impeller, the pulp was decanted, not filtered (filtration abstracts some of the soap from solution, especially sodium palmitate), and the concentration of soap in solution was determined by measure of the surface tension of the solution. The surface tension observed was compared with that of a solution of soap of known concentration.

Surface-tension measurements were made by the drop-weight method, also called the Traube stalagmometer method. This method is usually simple and of fair accuracy when only relative values are desired. However, one difficulty is met with when applying it to soap solutions.

The soap solution is colloidal in nature and the equilibrium between the surface film of the drop and the interior of the drop is only slowly established (Milner: *Phil. Mag.*, Vol. 13, 1907, p. 96). As a result, the weight of the drop or the number of drops corresponding to 1 c.c. of solution is strongly influenced by the rate of formation of the drops. When the drops fall too rapidly, their size increases and corresponds to a dynamic surface tension much greater than the static surface tension. To obtain results which are comparable, the drops should not fall faster than one in 5 or 10 sec., and their rate of fall should be kept approximately constant in all the tests. A static method of surface-tension measurement would at first sight appear preferable, but Bulkley and Bitner (United States Bureau of Standards. Research Paper No. 241, 1930) have shown that at least one hour is necessary before the surface tension of a solution of sodium stearate reaches true equilibrium and that during that time the surface must be protected against CO_2 from the air.

Results of the tests are shown in the graph on page 222. The two upper curves show the results obtained when oleic or palmitic acids were added to a solution of sodium carbonate without mineral. The reaction was practically complete. Nearly the whole of the fatty acid added was found in solution in the form of soap. The two lower curves show the results obtained when oleic or palmitic acid was added to a solution of sodium carbonate in the presence of malachite. About 40 to 60 per cent of

the oleic acid added went into solution in the form of soap; the rest was absorbed or reacted with malachite. With palmitic acid, on the contrary, only 10 to 15 per cent of the palmitic acid added remained in solution. This shows that malachite has a much higher abstracting power (I intentionally avoid saying "adsorbing") for palmitic acid than for oleic acid. Inasmuch as a concentration of soap, corresponding to about 75 mg. per liter of fatty acid, is necessary in solution for distinct frothing, one can understand why, under ordinary conditions of floating malachite, palmitic acid does not froth: the amount of soap going into solution is too small.

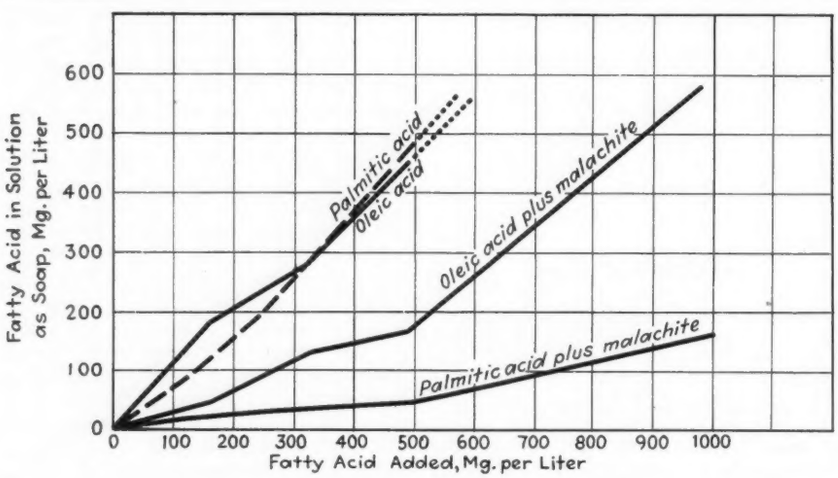
Some check tests were run using the soaps instead of the fatty acids. The soaps were slower in reacting with malachite than the fatty acids, but their action was entirely similar. The amount going into solution was much higher with sodium oleate than with sodium palmitate.

Apparently the difference between acid. This results from the following facts: When malachite is agitated in a solution of sodium oleate, the soapy froth first present disappears in one or two minutes and at the same time the malachite becomes coagulated and forms a heavily mineralized froth. The surface tension of the filtrate increases sharply and shows that only a fraction of the soap added is left in solution. *At the same time the pH of the filtrate increases.*

The results of two tests are shown in the accompanying table. In the tests recorded, minus-200-mesh malachite was used so as to present a large surface and to show a stonger effect.

Action of Sodium Oleate on Malachite

Test number	1	2
Before addition of malachite		
pH	8.8	9.4
Soap in solution, expressed in fatty acid—mg. per liter	1000.0	1000.0
After addition of malachite		
pH	9.0	9.7
Soap in solution, expressed in fatty acid—mg. per liter	27.5	35.0



Results obtained in the tests when oleic or palmitic acid was added to a solution of sodium carbonate without mineral are shown by the two upper curves. The two curves below show the results when malachite also was present

saturated and unsaturated fatty acids must be ascribed to the fact, disclosed by Harkins and Langmuir, that double bonds have affinity for water in the same was as carboxyl groups. In this way, unsaturated fatty acids have a much stronger tendency to remain in the water phase in the form of soaps than saturated fatty acids.

When fatty acids are added to an alkaline pulp, a part at least of the acid reacts to form a soap, and the question arises whether it is the acid or the soap which is the real collector, and what is the nature of the adsorption or chemical reaction taking place.

This can be said: When sodium oleate acts upon malachite it is not sodium oleate which disappears from solution and is abstracted by the ore, but oleic

The same sample of malachite added to a solution of sodium carbonate lowered the pH from 8.2 to 7.6. The increase in pH observed when malachite is added to the sodium oleate solution cannot therefore be ascribed to any alkaline constituent of the malachite used. Also, it must be noted that a solution of sodium oleate containing 30 mg. per liter of fatty acid has a pH of only 7.15. Therefore, the conclusion cannot be avoided that the fatty acid only is abstracted from solution and that the alkaline base remains in solution. This conclusion is in line with the observations of Taggart ("Chemical Reactions in Flotation," *Trans.* A.I.M.E. "Milling Methods," 1930) and of Gaudin and Wilkinson ("Surface Action of Some Sulphur-bearing Organic Compounds on Some Finely Ground Sulphur Minerals." The *Journal of Physical Chemistry*, Oct., 1933), that in the collecting reaction of xanthates the alkaline ion remains in solution.

This abstraction of oleic acid can be explained in two different ways: it is effected by an adsorption or by a chemical reaction.

The soap, a salt of a strong base, and a weak acid is somewhat hydrolyzed. An equilibrium exists in solution between the fatty acid and sodium hydroxide. If the mineral adsorbs the fatty acid, the equilibrium will be disturbed and hydrolysis will proceed and liberate new quantities of sodium hydroxide. In this way the solution will become more alkaline. It is not excluded that the adsorbed oleic acid will react later chemically with the mineral or that the mineral will abandon some CO_3 to the sodium hydroxide, forming sodium carbonate.

The second explanation, based on the chemical theory of flotation of Taggart, assumes that the soap reacts chemically with the mineral, forming an insoluble metallic soap and, in the present case, an alkaline carbonate.

To distinguish between these two mechanisms is difficult, but, without solving this question, a very important practical conclusion results from the fact that it is the fatty acid that is abstracted from solution, and not the soap.

Reactions Produced by Fatty Acid and Soap

When the mineral is floated with a fatty acid, the base in solution and the mineral compete against each other for reaction with the fatty acid. In this case malachite abstracts some of the oleic acid, which is not available any more for making soap and frothing; sodium carbonate reacts with some of the oleic acid, which is not available any more for collecting the mineral. When the mineral is floated with a soap, the situation is entirely the same. It decomposes some of the soap and abstracts the fatty acid; the sodium carbonate opposes this decomposition and retains a part of the fatty acid in solution. In other words, an increase in pH increases the frothing and decreases the collecting power of the fatty acids or soaps.

The observation has already been made by Gaudin (*Mining and Metallurgy*. Vol. 10, p. 19, 1933) that above a certain critical pH value, the collecting power of sodium oleate for activated quartz or feldspar disappears. This critical pH value depends of course upon the nature of the mineral and the nature and amount of the collector. Similar critical pH values have been observed by Gaudin (*loc.cit.*) and by Wark and Cox (A.I.M.E. Tech. Pub. 461) in the flotation of sulphides with xanthates, and they are apparently related to the fact that xanthates, in common with oleates, are alkaline salts of a somewhat weak acid.

Maintaining Ore Flow Through Bins

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A difficult and major problem at many plants — Effective solution requires exercise of considerable ingenuity—Design of bins, type of feeder, and character of the ore are the important factors

TECHNICAL literature is well supplied with data for the design of ore bins, by means of which proportions affording requisite strength and capacity may be determined. But to the operator struggling with "hang-ups" and the pernicious refusal of many kinds of ore to flow through the discharge openings, these data are not particularly comforting. That such difficulties are in the nature of a major problem is evident when one recalls that certain works were almost failures because of ineffective operation of ore bins. A description of some methods for keeping the ore moving through them may therefore be of interest.

For maximum capacity, with a given amount of construction, a flat-bottomed bin of cubic shape would be required. But, as such a bin would not be self-discharging or self-emptying, sloping floors are resorted to. If these sloping bottoms can be placed on two sides, with discharge through a number of openings along the center, little difficulty should be experienced. Frequently, however, circumstances require side discharge, necessitating a single floor sloping toward the opposite vertical bin side. In this instance, the angle of slope adopted must be given careful consideration. Usually the conventional angle of 45 deg. will move any ordinary ore. A very sticky ore may suggest the use of a steeper angle. Although 50 or even 55 deg. may be used, one should keep in mind that too steep a floor angle makes an acute angle between the floor and the side which may pinch the ore so tightly as to make it difficult to dislodge. Large lumps are prone to give trouble in bins of this kind. Should this difficulty be experienced, a remedy may be found in hoppering the bottom on each side of the openings. The cheapest way of obtaining this hoppering is to let the ore build up and form its own bottom. But for ores which must be sampled and accounted for by lots, a better procedure is to put in the extra hopper construction, if one would avoid hand labor in shoveling out the last remnant of ore in the bin.

All too often, however, the fact is forgotten that the corner valley between two sloping surfaces at right angles to each other is much flatter than the surfaces proper. To bring up an old point like this may seem superfluous, but many bins are still in use that have this flat corner angle in their hopper bottoms, holding back the ore so that it has to be pushed down.

In instances where flat-bottomed bins are used, and the ore is allowed to form its own slope, difficulties in getting the ore out of side gates can be diminished by having the bottom chute liner run back into the bin space for a distance of 2 to 4 ft. The ore will slide more readily on this smooth surface than it will on itself, particularly when started from rest. Once in motion, the part sliding down the chute bottom will tend to bring the main body of ore with and after it.

A number of troublesome problems of getting ore to flow through openings in vertical bin sides have been solved by moving the gates 3 or 4 ft. down the chutes. One or two stop boards, manually handled, move in guides perpendicular to the chute bottom, between the gate and the bin side. By means of these stop boards, any sudden rush of material can be controlled and prevented from leaping over the gate at the lower end of the chute. The material lying in the chute between the gate and the bin will usually start readily to move down upon opening the gate, bringing in its train ore from the bin. Should the ore arch across the bin opening, however, the arrangement described makes it easy to bar down, using the stop boards to prevent over-run. The proved effectiveness of this scheme suggests the advisability of studying the location of gates in bins when the ore fails to run out satisfactorily.

The location of feeders has considerable influence on the readiness with which ore may be drawn from bins. Theoretically, they should be placed so that ore runs down to them from the bins in such a manner as to avoid carrying the weights of high columns of ore upon them. The theory of this is that it saves wear and tear upon the feeders and minimizes the consumption of power. But for ores which do not flow readily this will not do at all. For such ore the feeders have to be so designed and so located that they actually pull the ore out of the bins. Wet sticky ores require heavy apron feeders that extend practically clear under the full widths of bin compartments. In the preferred design the aprons or pans are attached to chains which are carried on rollers keyed to shafts running in fixed bearings. Where the depth of ore is not too great, say 10 or 12 ft., canvas or rubber belts running on cylindrical rollers will often work well, maintaining the principle of running underneath the ore and drawing it out instead of depending on a flow of ore to the feeder.

A certain large metallurgical installation was condemned *in toto* because the bins feeding the ore to process were provided with feeders of the type that required the ore to flow to them. The general layout of the plant was excellent, and high-grade equipment had been provided. But the ore turned out to be extraordinarily sticky, so that it simply would not run. The only way the plant could be kept running was to throw a small army of shovelers into the bins to keep the ore moving down to the feeders. Even at that, an even feed could not be maintained, with the result that the work of the plant suffered seriously. In this particular instance the designing engineers could not justly be held responsible, as they had to do their work at a distance and were not given proper information as to the characteristics of the ore. Yet they had to take the blame for the failure of a whole plant, despite its otherwise excellent features of design,

just because the feeders would not feed.

Sometimes an upward inclination of a belt or apron feeder acts to agitate the material in a bin and thereby keep it moving. Fig. 1 shows a rather peculiar arrangement whose design was dictated by the fitting of new feeders to old bins. A maximum of headroom underneath the discharge was necessary. For this reason the tail pulley was the driving element, the head pulley being as small as possible. Both canvas and rubber belts were used. This installation, which has been in use for many years, gave surprisingly good results.

Frequently cylindrical bins are given conical shaped bottoms with outlets at the apexes of the cones. One should keep in mind that for such bottoms the angle of slope must be greater than for flat surfaces, at least 55 deg. for an ore requiring a 45 deg. flat surface.

If, in spite of this precaution, difficulty is experienced in drawing ore from a conical bottom with a belt feeder, a certain change may be made in the shape of the outlet that has often proved to be quite effective. This is best described by a comparison of the two diagrams shown in Fig. 2, indicating the original, and Fig. 3, the revised design. The change comprises the provision of a slotted opening in the cone, above the feeder, covered by flat plates, the discharge point being brought forward to a location under the outside circumference of the bin.

Bins of the design shown in Fig. 3 have proved to be quite successful in moving fine heavy concentrates. In some instances the canvas or rubber belts which were satisfactory for table concentrates were later replaced, with good results, by steel apron feeders for very sticky flotation concentrates.

If ore of a sticky hanging nature is to be handled, louvres should be provided, particularly above gate openings, through which the ore may be barred down (see Fig. 4). The louvre construction has been applied to entire sloping bin bottoms, not so much to facilitate poking down as to prevent ore sticking to an airtight bottom and being held in place by atmospheric pressure. One successful design resembled that shown in Fig. 5. But any one who has ever sweat and struggled to start ore moving after it has packed in a bin over the gates or feeders will appreciate an arrangement which will permit barring the ore down without being compelled to do it through the gates, with the accompanying risk of runaways and personal injury.

A design of bin for this purpose, which is becoming popular in Europe, is shown in Fig. 6. In this instance reinforced-concrete construction is used, with a horizontally revolving plate feeder underneath. Although quite compact, the design affords good access to the bin interior. In a sense this design could be considered a development from an old American design which used a separate hopper for the feeder supply below the bin proper, as indicated in Fig. 7. This design has recently been revived for plants with flotation concentrates that are difficult to handle; at such plants it has proved to be quite useful. The arrangement, one will note, gives access to the bin interior on all sides.

Another interesting European design is shown in Fig. 8. Although this design was worked out primarily for the purpose of permitting storage in long overhead bins without the necessity of building long expensive trestles to bring ore trains over them, it has other advantages. Material unloaded from the sides of the railroad cars is reclaimed through chutes or feeders onto conveyor belts which finally deposit it in the upper parts of the bin or carry it to its destination for processing. Several variations of this design are used, such as the provision of only one conveyor or several conveyors, or the simple use of the tunnel to permit access to the bin interior and the tops of the feeders. This latter feature is emphasized in this discussion.

Sometimes the material of which a bin bottom is built has rather surprising influence on the flow of ore. In this connection I recall the construction of certain large bins for iron ore. As the ore to be handled was wet and sticky and likely to be hard to manage, careful study was given to the shape of the bins to be adopted. The steeply sloping bottoms were made of smooth steel plate with all rivet and bolt heads carefully countersunk so as to leave no projections to impede the flow of ore. Outlet gates were closely spaced. The shape and material appeared ideal for good movement. But, to the surprise and consternation of all concerned, the wet ore hung up most persistently, requiring constant poking and shoveling to make it move. As the conditions of operation required rapid filling and emptying of the bins, this development resulted in heavy expense. After several expedients which were tried had failed, a very simple one solved the problem. This was the lining of the smooth steel plate bottom with rough wood plank! The explanation of the success of this scheme is undoubtedly the same as for the louvred bottoms—namely the prevention of a vacuum at the surface of contact of the ore with the bin bottom, with its resultant atmospheric compression of the ore to the smooth steel plate floor.

To predict in advance just how certain ores will slide on floors of different types is not always easy. Yet one may expect that fine, wet, slimy ores will exhibit a tendency to stick to smooth steel plates. On the other hand, for reasonably lumpy ores, steel plate is the preferred material, being, in fact, generally used for lining bins of both wood and steel, to take up wear. One detail in the arrangement of this lining

Fig. 1—Here new feeders were fitted to old bins. The upward inclination of the feeder is intended to keep the ore in the bin agitated. Figs. 2 and 3—Original and revised designs respectively, the shape of the outlet having been changed in the latter.

Fig. 4—Louvres for inserting bars have been provided here above the gate openings, the ore being sticky. Fig. 5—A successful use of louvres in the bin bottom, to prevent ore from sticking to an otherwise airtight surface

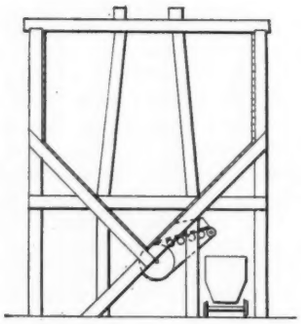


Fig. 1

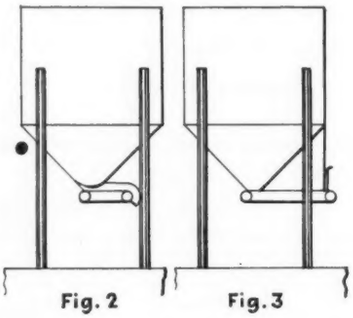


Fig. 2 Fig. 3

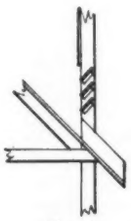


Fig. 4

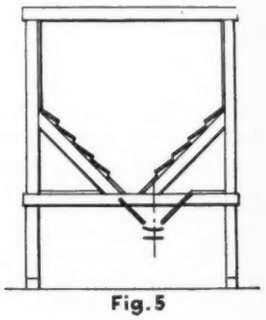


Fig. 5

will save considerable trouble if properly applied. One frequently finds that after steel-plate linings have been in service for a while they begin to come loose at their edges and the corners curl up. In this condition the flow of ore is obstructed in an exasperating manner. If, when installing liner plates, all vertical joints are covered by butt straps and the holding-down bolts and rivets are made to pass through both plate and butt strap, the wear on the liner plates will be considerably minimized and the troublesome curling up of corners eliminated.

Winter conditions bring their own peculiar difficulties in the handling of ores. Yet these difficulties can be overcome by quite simple means. For mine bins, one should remember that ore as it comes up from underground is generally many degrees warmer than

variant of this where the excavation cost might prove excessive is to put the bins only part way, say one-half or two-thirds of their depth, into the ground and then bank up the sides with earth. Some objections to the scheme are the liability to flooding of the pit in rainstorms, the necessity for continuous artificial light, difficulty of ventilation, awkward access for repairs to gates, feeders, and conveyors, and the accumulation of rubbish below on the principle of "out of sight out of mind." But that the arrangement has its advantages cannot be denied. The ore is brought up from below by conveyors. Cost of excavation is offset by the elimination of a long approach trestle to the top of the bins. As for the effectiveness of the protection of the ore against freezing, one has but to keep in mind the effectiveness of

the ore pile for protection against rain is essential in most places. A prominent American copper smelter stores most of its ore receipts in a completely housed-in building, flat on the floor, whence special reclaiming machines put it onto conveyor belts.

The system suggested in the foregoing is really an intermediate between the ore yards of large blast-furnace plants, with their huge grab-bucket ore-reclaiming bridges, and the strictly all-bin systems which prevail in most nonferrous mills and smelters. Although gravity flow through bins is desirable, special conditions exist where ground storage offers sufficient advantages to justify giving some consideration to it.

But at this point the operating man may be exclaiming: Oh, yes. That is all very well. In fact, hard experience has shown us a lot of things we would

Fig. 6—A type of bin popular in Europe. The barring down of ore is facilitated.
Fig. 7—This old American design used a separate hopper for supplying the feeder.
Fig. 8—Another interesting European design

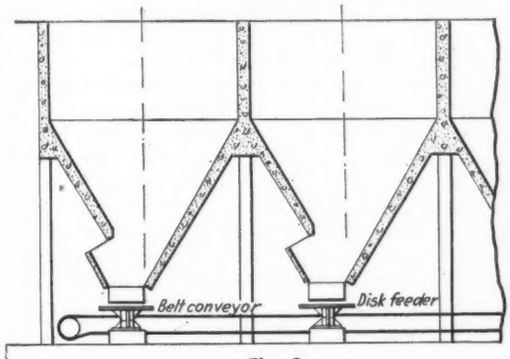


Fig. 6

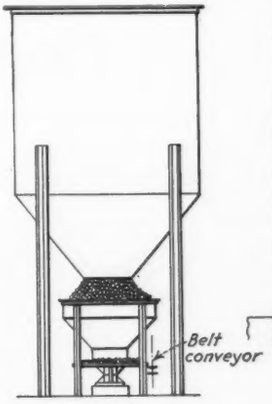


Fig. 7

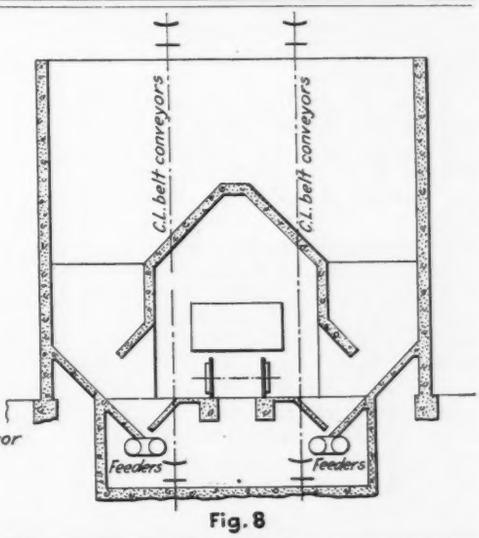


Fig. 8

freezing. If therefore mine bins are kept covered, above and below, and the ore is kept moving so that it does not remain long in the bins, little trouble should be experienced. If, however, it has to be shipped some distance to mill or smelter, the situation is different. The railroad thaw house is an effective weapon against such winter difficulties, but its use is outside the present discussion.

Simple as it is, the practice of covering bins to prevent freezing of ore is frequently disregarded. In the course of world-wide travels, I have often seen ore bins with burning salamanders or steam pipes and radiators beneath them, the bins, at the same time, being wide open to the atmosphere on top. A plain decking over the top with trap doors through which to drop the ore, kept closed when not in use, will obviate much trouble.

One arrangement for protection against freezing, which is probably more used in Europe than in this country, is the placing of the ore bins entirely below the ground level. A earth cellars for carrying vegetables through the long, cold months of winter.

Where the ore to be handled appears to be of such a nature as to be excessively difficult to handle through bins, no matter how well designed, one solution of the problem is to use no bins at all! Such ore can be stocked in piles underneath railroad trestles or put into triangular section piles by belt conveyors, after the manner of the well-known Messiter ore-bedding system. Various methods of reclaiming or of drawing have been used. A simple one is the use of a belt conveyor running in a tunnel beneath the ore pile, with boards over the tunnel which are progressively taken up to permit the ore to drop into the conveyor below. Reclaiming machines of various types have been used to bring down the ore from the pile. A German type uses an endless chain of scraper drag buckets, mounted on a self-propelling carriage. One of the African copper smelters uses the reclaiming machine developed for the Messiter ore-bedding system already mentioned. A light roof over

like to do in order to make our bins run more freely, but what is one to do in these days when money for new construction is so difficult to obtain? Perhaps mention might well be made of some simple expedients which have actually worked in overcoming difficulties in making ore move.

The old rule of making minimum dimensions of openings through which ore must flow at least three times the size of ore pieces when sized or twice the largest size when coarse and fine are mixed is altogether too often overlooked. Enlarging gate and feeder openings has often effected magical results in relieving troublesome bins. A slight outward flare of chute sides has also proved to be helpful—often surprisingly so.

Compressed air can be used in several ways to bring down ore which hangs up. One of these is to make a poke rod of a piece of pipe, with a simple nozzle at one end and a hose connection to a source of compressed air at the other, with a plug cock to regulate the pressure and quantity. This device has

been effectively used in freeing fine sticky ore.

Another manner of using compressed air to cause ore to move is through the medium of pipes laid on the bottoms, and occasionally along the sides, of bins. These pipes, which may be 1¼ to 2 in. in size, have a series of small holes, about ⅛ to ¼ in. diameter, drilled in them. The most persistent instances of hang-up of wet slimy ore have been overcome by blowing air through such pipes. The expedient does not work with loose lumpy ores, for then the air simply blows through their interstices. It was a failure, for example, when tried on sinter. But for dense compact ores it is quite effective. Frequently underground ore bins are cut out of the solid ground, usually with no way to get at them except through the small openings of the discharge gates, making them particularly difficult to bar down. Some very troublesome situations in ore bins of this kind have been overcome by the use of compressed air in the manner described.

Where ore tends to freeze and the existing bins do not permit the use of such expedients as double bottoms through which hot gases may circulate, the installation of steam pipes and radiators, complete housing-in, and other arrangements, then the ore can often be started by the direct application of steam. This is accomplished by cutting holes in the bin sides or bottoms and inserting pipes or "lances" in them, through which steam can be blown directly into the ore. When one recalls that the condensation of a pound of steam releases about 1,000 B.T.U., one can understand why this scheme thaws ore so quickly. If not handled with discretion, the steam lances can waste a lot of steam. But they are certainly effective, particularly in opening up frozen gates and the ore around them.

Even in good weather, however, and when handling dry coarse ore with a small amount of fines in it, hang-ups may be experienced, owing to certain peculiarities of lump shape which may cause the ore to arch. In such instances, external rapping of the bins is usually resorted to. Where this is unavoidable, some sort of reinforcing plate may be attached to the bin to take the blows of the hammer or mallet used, for otherwise the bin will suffer eventual damage from frequent pounding. If such precautions had been taken with many bins now in use, they would not have acquired their present sad condition, and generally be referred to as "having been hammered all to pieces." A piece of ½- or ⅝-in. plate riveted to a steel bin or bolted to a wooden one at the point of hammering will prevent a considerable amount of damage.

The fact that certain kinds of ore do not flow readily without at least some small amount of agitation has led to the introduction of mechanical, pneumatic, and magnetic means of imparting vibration to bins. An interesting new device is a magnetic vibrator built upon the principle of the vibrators used for magnetic screens and applied directly to steel bins. They can be set to vibrate continuously, intermittently, or from time to time as may be needed. For certain conditions these are quite useful.

Interior mechanical agitators of various types are in use in many industries. For heavy metallic ores they are not entirely successful, often giving more trouble than help. A fairly good rule is to keep bin interiors quite clear and free of anything except the ore itself.

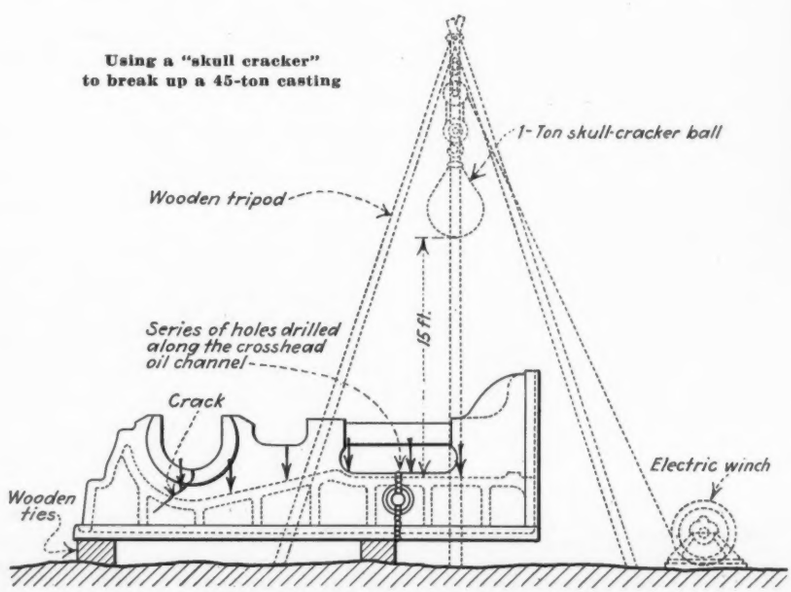
When all is said and done, however, times will occur when the best of designs and devices will fail to keep the ore moving, without resort to direct man-power. Nevertheless, resourcefulness has developed many helps for the most difficult of situations which cannot be recorded here because of the limitations of space. The vivid memories of bitterly cold winter nights, fast-running furnaces swallowing up charges faster than they could be gotten out of the bins, mills silenced because the feeders were running empty, sintering charges dropping off the machines cold and raw because one ingredient of the charge had failed, demurrage piling up on railroad cars in the yard which could not be unloaded because the bins into which they should be discharged were full and hung up, and all the other troubles resulting from erratic movement of ore through bins, have prompted the setting down of these words in the hope that they may provide some helpful suggestions.

Demolishing a 45-Ton Casting With a "Skull Cracker"

AT THE POWER PLANT of a well-known mining company operating coal and lead mines in central Spain, the 45-ton frame of a 2,000-hp. gas engine failed and had to be replaced at once. To avoid congestion and to facilitate installation of the new frame, the old one had to be removed to a small lot between the power house and the gasometers and there broken up into scrap for the local foundry. Moving the frame presented no difficulties, but demolishing it was another matter, because the use of explosives was out of the question on account of the proximity of the gasometers, and because, save for a one-ton "skull-cracker" ball and a 35-ft. wooden tripod, no tools were available at the plant or near by.

After a careful study of the problem, which took into account the cheap labor available in the district, decision was finally made to break up the engine frame with the ball and an electric winch in the manner shown in the accompanying sketch. First, the wooden tripod was mounted over it and the frame floor demolished by allowing the ball to strike the floor at the points indicated by arrows. The ball was raised by an electric winch, and three to four blows usually sufficed to effect breakage. Next the frame was raised by jackscrews and set upon wooden ties, after which a series of holes were drilled along the crosshead oil channel by two men and two helpers.

Using a "skull cracker" to break up a 45-ton casting



A New Stack for the Salt Lake Valley

C. C. Burt

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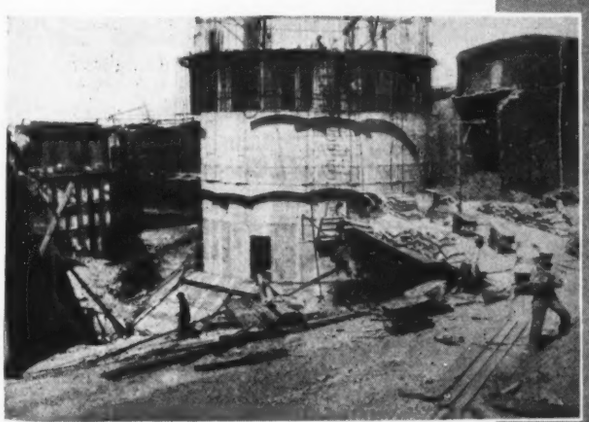
Garfield smelter replaces old cracked chimney with one of concrete . . . Cramped site adds to the ordinary difficulties of construction

ROASTER and reverberatory gases were turned into the new reinforced-concrete stack on Nov. 15 last at the American Smelting & Refining Company's plant at Garfield, Utah. This stack was built to replace the old one, which not only had been erected years ago, before the days of the Cottrell plant, but, in addition, had become badly cracked. This replacement, in connection with the new flues that have been constructed, has permitted the company to scrap about 1,000 ft. of old flue which was expensive to clean out and to maintain. In short, the decision to build the new stack was dictated by necessity and the desire to secure greater efficiency and orderliness. Design and construction of the approach as well as the excavation for the stack were carried out by the company. The stack proper and its foundation, however, were designed and erected under contract.

The original design called for a stack 405 ft. high with an inside diameter of 27 ft. at the top and 29 ft. 11 in. at the bottom, both measured inside the tile lining. As actually built, the stack measured 407 ft. 9 in., not including the tile cap.

The soil on which the stack was built consists of alternate layers of closely compacted sand and gravel which had been deposited by water, either by run-off from the adjacent hills or possibly by wave action, as the site is considerably below the Provo Bench line of Old Lake Bonneville. A bearing test applied several feet below the bottom of the foundation with a load of over 5 tons per square foot showed no settlement.

Octagonal in shape, the foundation is 8 ft. 6 in. thick and measures 55 ft.



• THE NEW STACK of the American Smelting & Refining Company's plant at Garfield, Utah, is 407 ft. 9 in. high above its foundation and of 27 ft. inside diameter at the top and 29 ft. 11 in. at the bottom

• POURING OF THE FOUNDATION, which is octagonal in shape and contains 630 cu.yd., required 64 hours. That of the stack shaft began June 20 last and was completed Sept. 5

6 in. across the flat at the bottom and 38 ft. at the top. It is heavily reinforced both top and bottom, the bottom steel being laid in four layers at 45 deg. and at 90 deg. to each other, whereas the top steel consists of only two layers laid at 90 deg. to each other.

At the top the concrete shaft is 7 in. thick, and it is 8½ in. 200 ft. down and 30 in. thick at the bottom. On each side of the flue opening, the bottom thickness increases to 39 in., this gradually decreasing to the regular 30-in. thickness at points 90 deg. from the center line of the opening.

One-inch square steel bars, 150 in number, serve to dowel the shaft to the base. The entire height is reinforced with vertical bars located near its outside face and tied together with spiral rings of ½-in. round bars.

A concrete mix was selected that would produce 2,500 lb. of concrete in the base, 3,000 lb. for the lower 305 ft., and 3,500 lb. for the top 100 ft. The water content was rigidly controlled and the aggregate was required not only to meet the ordinary tests but to be low in lime. Water curing was used on the outside only. After pouring was completed, the inside and the upper 200 ft. of the outside were painted with three coats of silicate of soda diluted with varying proportions of water. The upper half of the outside was also painted with asbestos-fibered gilsonite paint.

Detail of Tile Placement

Salt-glazed, vitrified, radial tile 4 in. thick, and supported on concrete corbels 30 ft. apart, compose the lining. The corbels are wide enough to allow a 2-in. air space between the concrete shaft and the tile and are protected by tile blocks so designed as to keep dust from getting into the air space behind the lining and at the same time to allow the lining to expand either up or out. A cap, made of bell-and-spigot style vitrified tile bolted to the concrete shaft, covers the top so as to prevent water getting down between the lining and shaft. The tile were laid in a mortar made of silicate of soda and pure silica sand. After completion this mortar was set by painting with sulphuric acid. The usual ladder and lightning rods were provided as well as a painter's trolley rail around the stack near the top.

The 12-in. concrete side walls of the approach flue are at right angles to each other and, if projected through, would meet on the line between the center of the flue opening and the center of the stack at a point about 11 ft. from the stack center. They are joined by 10-ft. radius curves to the sides of the stack opening, which are on radial lines, with the opening measuring 12x48 ft. at the inside of the stack lining. The top of the approach flue slopes up toward the stack at an angle of 45 deg. The converging sides and sharply upward-sloping roof make an approach resembling a fish-tail burner in shape and reducing the entrance draft loss to a minimum.

A wood and composition roof was provided to keep rain off the flue top. Both this rain roof and the flue top are carried by deep steel trusses, the roof sloping 8 in 12 in. away from the stack and resting on the upper chord of the trusses; the flue top slopes at 45 deg. and is carried by the lower chords. The flue top is made of corrugated transite protected on the bottom by a minimum of 2 in. of gunite and insulated on the top by a minimum of 2 in. of Weber's 48. The entire inside of the approach flue was painted with asbestos-fibered gilsonite paint.

At the other end the short approach flue connects to towers in the three old flues. Vertical, sectional, cast-iron louvre dampers were installed at the junction of the approach flue and each of the towers to provide a means of controlling the draft independently in each of the old flues.

Room for storing materials during construction was restricted, inasmuch as the stack was situated on a steeply sloping, triangular plot bounded on one side by the main yard railroad tracks, on another by the existing flues and directly opposite the wing wall of a flood control dam located in a dry wash which formed the third side of the triangle. The tracks were about 100 ft. from the center of the stack and 14 ft. below the top of the foundation, and the top of the wing wall was about 13 ft. above the foundation top.

A spur track was built, rising as fast as possible and ending at the foundation edge. The dirt removed in excavating for the stack foundation was dumped back of the wing wall to form a terrace a little lower than the top of the wall and about 45 ft. wide on top, with its toe along the edge of the track and the stack foundation. Directly opposite the stack a heavy platform was built over this slope, slightly higher than the terrace. Two ¾-cu.yd. mixers were placed on this platform about 12 ft. apart, 35 ft. from the center of the stack and about 12 ft. above the top of the concrete foundation. They delivered into chutes sloping 6 in. in 12 from the mixers to the inside of the stack and 2⅝ in. in 12 from there to a 4-cu.ft. hoist bucket at the center of the stack. This last chute had a gate in its end and served as a storage bin between the mixers and the bucket. The bucket, after hoisting, was dumped into a movable chute having one end near the center of the stack and the other end resting on the inside form.

All material was spotted on the short spur track and unloaded by a 1-cu.yd. crawler crane located on the top of the terrace. Cement came in paper bags and was stored in a small shed beyond the mixers and just in reach of the 40-ft. boom on the crane. Small storage piles of sand and gravel were maintained at the side of the crane, but the available space was so limited that it was necessary to have accurately timed deliveries of all material.

Adjustable steel forms were used both inside and outside. These provided for pouring a section 7 ft. 6 in. high, but there was a small gain in each pour, which resulted in an increase in the total height of the stack. The working platform at the top was supported on timber posts reaching all the way to the foundation, with occasional bracing against the stack shell to resist the side thrust. The order of operations for a 7 ft. 6 in. section was as follows:

1. Raise working platform.
2. Raise outside forms 7 ft. 6 in. and align them.
3. Raise inside forms 3 ft. 9 in. and align them.
4. Place reinforcing steel.
5. Pour lower half of section.
6. Raise inside forms 3 ft. 9 in. and pour the upper half of the section.
7. Allow twelve to sixteen hours' intermission to permit concrete to set; then repeat.

The Crew and Its Record

The normal crew for mixing and placing, exclusive of the general foreman, consisted of seven men at the mixers, a hoist man, one man loading buckets, and three men on the working platform.

Pouring of the foundation, which contained 630 cu.yd., started June 11 and continued 64 hours, ending on June 13. Pouring on the stack shaft was started June 20 and completed Sept. 5.

Heavy timbers from which a movable platform for the masons was suspended were then placed across the top of the stack, and the old scaffolding was removed. This required until Sept. 14, when painting the inside with silicate of soda started.

Setting the tile lining started Sept. 19 and was completed Oct. 23. Placing the cap, the acid treatment of the mortar, and outside painting took until Nov. 14.

Curing the stack was accomplished by the use of coke salamanders, which were fired on afternoon and midnight shifts on Nov. 8 and 9 and continuously thereafter until the morning of Nov. 15. A small wood fire was started in the entrance flue at 3 o'clock that afternoon, and ten minutes later the stack starting pulling part of the gas. This continued until the middle of the next forenoon, when the flow to the old stack was cut off and the entire gas stream diverted to the new stack.

Detachable Bits

Cut Drilling Costs At Mother Lode Mine

•

Test Made at Spring Hill Property Over 51-Day Period

USE of detachable bits is increasing in mining practice as well as in quarrying operations. This is due to the economic advantages which they offer, plus the convenience and simplicity of handling bits alone instead of quantities of drill steel.[1]

At the Spring Hill mine, at Grass Valley, Calif., a test run was recently made in which Timken removable rock bits were used. This test was under the personal supervision of the superintendent and general manager of the property, and detailed cost studies were made. These show that the use of the removable bits saved not less than 40 per cent in drilling cost and approximately 60 per cent in steel cost.

Machine runners at the mine work on a contract basis. They were familiar with the ordinary bitted steel, but saw the possibilities of detachable bits in eliminating delays and in speeding up their drilling. The Timken bit screws on the end of standard drill steel, using a specially designed left-hand thread. The steel does not bottom in the bit, nor is the force of the blow transmitted through the threads. When drill steel is prepared for the bit, a shoulder is forged back of the thread and the bit seats on this shoulder. This permits the drilling force to be transmitted uniformly to the bit, and the design of the seat is such that no sharp shoulder exists, the construction noted thereby avoiding difficulty from collaring.

The California study covered 51 days of operation in diabase, serpentine, and quartz vein material. During this period 831 ft. of drifting and cross-cutting was accomplished in 195 machine shifts. Gardner-Denver Model 11 and S55 machines were used with $\frac{7}{8}$-in. hexagonal hollow drill steel converted for use with Timken bits. A footage of 10,085 ft. was drilled during the study, using 1,422 bits, showing an average of 7.09 ft. per bit. The hardness of the rock varied over a wide range, which of course affected the footage per bit. For example, when drilling in soft serpentine one bit made a maximum of 180 ft. before getting dull, and an average of 113.3 ft. per bit was made by three bits used in six shifts drilling a total of 340 ft. In hard diabase, 3.8 ft. per bit was secured, which is satisfactory, as was the minimum figure of 2.47 ft. per bit, made in a particularly hard quartz section of the vein.

A COMPARISON AT THE SPRING HILL MINE

In the carrying rack held by the driller are sufficient Timken rock bits for his day's work. Beside him is the amount of sharpened, or bitted, steel that he would otherwise require for the same amount of drilling

To keep track of the progress of the test, the superintendent made a daily estimate of the number of machine-forged bitted steels that would have been required to give an equivalent footage, reporting that 2.19 times as many ordinary sharpened (bitted) steels would have been needed to do the work done by a single removable bit. He estimates that 3,114 bitted steels would have been required for the test operation. The removable bits were used, on an average, four times before they were discarded, being reground three times. A total of 317 bits were used to the point of discard during the study.

Operating costs with these bits were calculated as follows: 317 bits, used to discard, at 32c. each, equals $101.44; converting (threading and shouldering) 12 rods to use these bits, at $1 each, equals $12; regrinding 1,105 bits at 7c. apiece equals $77.35; a total direct operating cost of $190.79. This shows a direct cost of 1.89c. per foot of drilling, or 22.9c. per foot of development work. Corresponding figures when using bitted steels showed a direct drilling cost of 3.08c. per foot of drilling and 37.4c. per foot of development.

Important savings are also readily apparent in the amount of capital tied up in steel. To provide sufficient bitted steel to maintain operations over a period corresponding to this test, the management states that a minimum of 250 rods would have been required. These steels, weighing about 2,000 lb., at 14c. a pound, would represent an investment of $280. To this must be added the cost of bitting and shanking, which at 75c. per steel would amount to $187.50, thus showing a total initial investment of $467.50 before drilling started. When using the detachable bits, however, only 12 rods converted for using the bits were required, representing an investment of but $39.60. To this may be added the initial cost of the bits used, or 317 at 32c., equal to $101.44. A total of 400 bits had been purchased originally. The basic comparison of steel investment shows a first cost of $141.04 for the removable bits as opposed to $467.50 if sharpened steels had been used.

Still another saving was made that will show up in the reduced cost of mine operation over a period of time, even though the individual economies can hardly be segregated for a short test period. For example, the use of removable bits reduces lost holes and lost steels due to collaring and sticking. Steels are likely to last longer when removable bits are used, as the driller no longer has a good reason for continuing to use a dull steel when his stock of bitted steels begins to get low. He can easily keep a sharp bit on the steel, for to carry in a full day's supply of sharp bits to the working face is no trouble at all. Not only is drillers' time saved, but also that otherwise consumed in nipping and in unproductive car use and hoisting of steel.

Detachable bits eliminate the necessity for forging and heating equipment, as well as reduce the charges for air. Further, factory-made bits are more durable, more uniform, and sharper. Steels are not subject to damage by overheating or improper forging by careless workmen. Steel on hand can be readily converted for use with modern detachable bits without waste.

[1]See also "Drilling With a Detachable Bit," *E. & M. J.*, November, 1932, pp. 582-87.

How to Make an Alignment

A Simplified Way of Constructing Nomographs to Aid in Daily Milling Calculations

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IN A MODERN flotation plant, the optimum metallurgical efficiency depends very much on the control of measurable variables. Many complex ore-dressing problems, in plant practice, may be simplified by grouping constants employed, and substituting the factor or factors found. The simplified formula may not be of much help to the workmen operating flotation units, classifiers, ball mills, or other units, for several reasons. However, the graphic solution of nearly every mill problem will allow every millman to measure his milling results. The alignment chart, or nomograph, whereby this graphic solution can be effected, can be used by any plant employee because such use is easy and practical. Mill workmen can and will do better work if they are provided with aids such as a graphic chart.

The literature covering the construction of alignment charts usually assumes that the reader is a proficient mathematician. This type of chart, however, can be constructed by almost any reader after a study of these notes. Moreover, the construction of one simple chart will indicate to him how more complex formulas may be presented in graphic form.

The tools needed for constructing charts of this sort are few: a 12-in. engineers' triangular scale divided into 10 to 60 parts to 1 in., a straight-edge, and cross-section paper having 10 by 10 lines to the inch. Inasmuch as logarithmic alignment charts are less troublesome to the user, these notes will refer only to this type of chart.

First, logarithmic work sheets must be prepared: one giving a "unit" scale for the numbers "1" to "10" and one sheet for the subdivision of each unit into "tenths."

The "Unit" Scale

A piece of cross-section paper, not less than 12 by 12 in., is divided on one edge into distances, measured from one point, equal to the logs of the numbers involved, like the "C" or "D" scale on a slide rule. The sheet shown in Fig. 1 is divided into log distances for the numbers "1" to "10." These are given by the following:

1 is	log	0.000 000
2 is	log	0.301 000
3 is	log	0.477 121
. . .		. . .
9 is	log	0.954 243
10 is	log	1.000 000

This scale from "1" to "10" can thus be considered to have 1,000 divisions, using a three-place log table. At the lower-left corner of the cross-section paper mark a point and call it "1." Then 301 divisions[1] above this point will be marked "2"; 477 divisions above "1," mark "3." Continue thus until all the numbers are located. At the lower-right corner of the cross-section paper push a pin into the paper and from it, as a common meeting place, draw lines to each numbered point on the left-hand edge. Any line parallel to the calibrated vertical line is divided by the oblique lines into divisions equal to the logs of the numbers "1" to "10."

Similar graphs are then prepared for each unit ("1" to "2," "2" to "3," and so on) of the scale on the left-hand edge of Fig. 1, each being divided into "tenths." For example, the unit "3" to "4" is laid out in Fig. 2 according to the following:

3.0 is	log	0.4771 21
3.1 is	log	0.4913 62
3.2 is	log	0.5051 50
. . .		. . .
3.9 is	log	0.5910 65
4.0 is	log	0.6020 60

Using a four-place log table, one finds there are 1,249 divisions between the log numbers of "3" and "4." The vertical line at the left-hand edge of Fig. 2 is therefore to be regarded as being divided into 1,249 units. In the lower-left corner mark a point and call it "3." Then the difference between the logs of the numbers "3.0" and "3.1" is scaled off vertically above it, this difference being 4,914 less 4,771, or 143 divisions. Therefore, point "3.10" is located at the equivalent[2] of 143 divisions above point "3." Continue this operation until all the "tenths" are located on the vertical line. On the lower end of the opposite side and perpendicular to the vertical line at the point marked "3," establish a point, to be the common meeting point for straight lines drawn from each marked point on the left-hand vertical line. Again, any line parallel to the calibrated vertical line is divided by these oblique lines into divisions equal to the logs of numbers "3.0" to "4.0" by tenths. Next, a graph similar to that in Fig. 2 is made for each of the remaining "units" of the calibrated scale on the left-hand edge of Fig. 1. This done, one now has a complete set of "log charts" for making almost any alignment chart. Should a chart require finer divisions, the reader can easily prepare the scale in the same way as that in which these charts were made.

Making a Simple Reagent Chart

Let the first chart be constructed to aid in making the following practical flotation mill calculation:

"How many cubic centimeters of a 5 per cent solution of xanthate must be added to a flotation circuit, in one minute, so that the pulp will be using 0.5 lb. dry reagent per dry ton of solids

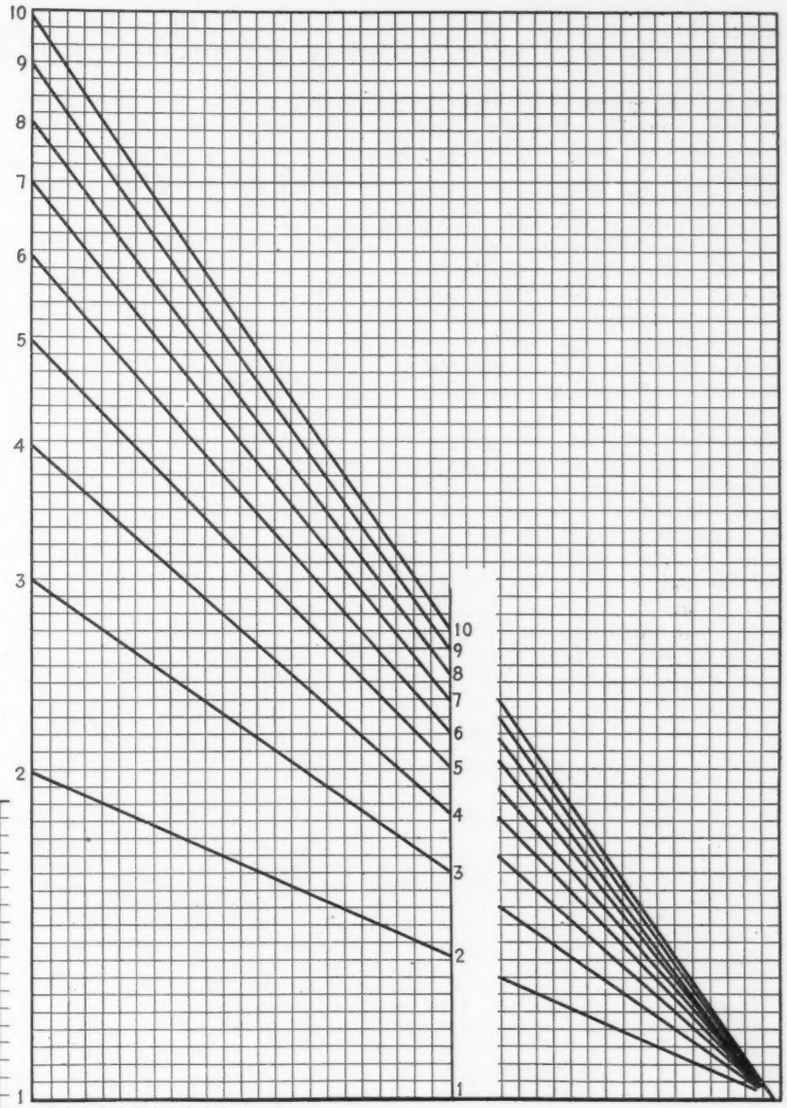
[1] In reproducing this cross-section paper in Fig. 1, it is of course not practicable to show 301 divisions between points "1" and "2." As shown, each subdivision represents 16 "divisions" referred to in the text.—Editor.

[2] For a reason similar to that given in footnote 1, each subdivision, or square, of the cross-section paper shown in Fig. 2, represents 21.7 of the "divisions" referred to in the text.

Chart

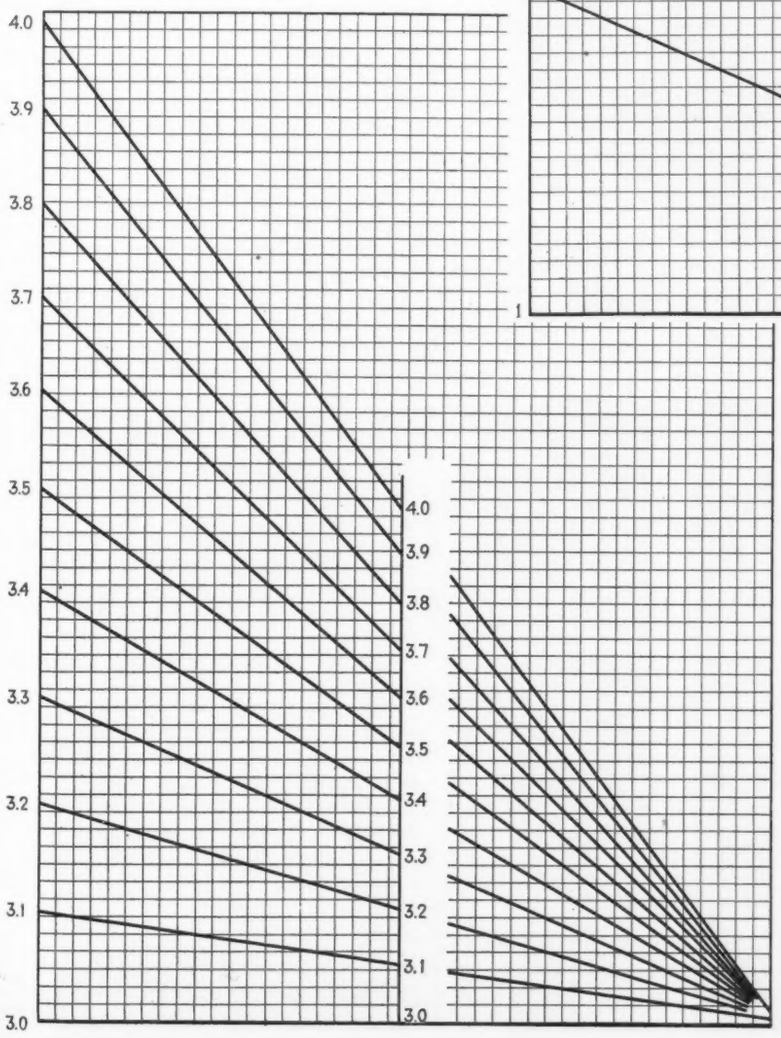
Unit Scale Graph

Fig. 1 — Logarithmic work sheet giving a "unit" scale for numbers "1" to "10." This and the sheet shown in Fig. 2 are used in making the nomograph on page 232



Subdivision Graph

Fig. 2 — Logarithmic work sheet giving the subdivisions, in "tenths," of the first unit ("1" to "2") of the scale in Fig. 1



when 6 tons of dry pulp per hour is flowing in the circuit?"

Let it be assumed that this flotation circuit treats each hour from 2 to 10 dry tons of solids. Also, that the specific gravity of the xanthate solution is 1.000 (this is not necessary, any specific gravity can be used, provided the "weight per cent" of the solids in solution is plotted).

Derivation of the formula presented in the foregoing is not essential. Note that three "variables" are present: the "tons per hour" flowing through the circuit, the number of "c.c." per minute of xanthate solution being used, and the "pounds of dry reagent per dry ton of pulp." Knowing any two numbers, the third may be calculated, quickly and accurately, by an alignment chart.

A plain piece of paper at least 15 by 15 in. will be used for this chart, which is shown in Fig. 3. On one side, near the edge, a vertical line is drawn. On the opposite side of the paper, near the edge, another vertical line is constructed

parallel with the first line. One line is divided into "logs of the numbers 2 to 10," starting with "2" near the bottom. Make the line as long as desired. Mark this line, "Tons Dry Solids per Hour." Divide each unit into "tenths," by log divisions.

The other vertical line is divided into two equal parts. Each half is divided into the logs of the numbers "1" to "10," and each of these divisions is divided into "tenths." This line is marked "Pounds of Reagent (Xanthate) per Dry Ton Solids." The lowest point on this line is marked 0.01 lb., the middle mark is 0.10 lb., and the top mark is 1.0 lb.

Somewhere between these two calibrated vertical lines will be constructed a third line, parallel to both, and this line will be marked, "Rate of Feed of 5 per Cent Reagent Solution in One Minute in Cubic Centimeters." To locate this line, calculate the number of "c.c." of the 5 per cent solution per minute that will give *one-half pound reagent* per dry ton feed when *10 tons* of dry solids flow through the circuit in one hour. Repeat the calculation when *one* pound of reagent is required per ton when *5 tons* of solids flow through the circuit. The number of "c.c." per minute in each case will be the same.

$$\left(\frac{5\times453}{60\times0.05} = 755 \text{ c.c. per minute, as}\right.$$

5 lb. of reagent must be supplied to the circuit each hour.)

On the chart, draw lightly with a pencil a line from "10 tons" to "0.50" lb. reagent and another line from "5 tons" to "1.0" lb. of reagent. Where the two oblique lines cross is the location of the third parallel line.

Now draw pencil lines from "10 tons" to "0.05" lb. reagent and "5 tons" to "0.10" lb. reagent. A line parallel to the two side lines should pass through the crossings made by the oblique lines. The distance between the two points on the middle line, made by the crossings of the oblique lines, is the "unit" length for the calibration of the middle line. The two points should be marked lightly "75.5" and "755." Take a piece of paper with a straight-edge and lay it next to the middle line. Mark on this paper the points "75.5" and "755." Now lay this piece of paper on the "unit" log scale from "1 to 10," so the "755" is opposite where 755 would be found on the work sheet. Now transfer the balance of the numbers from "1" through "755" to "10" on the piece of paper. Remember that any line parallel to the calibrated line is divided into the logs of the numbers. With the small piece of paper now calibrated into "logs of the numbers," transfer these distances to the chart being constructed. Complete the calibration of the third parallel line above and below the points established by calculation and construction.

Check the figures on the chart as follows: read the number of "c.c." per minute required to give 0.01 lb. of reagent per dry ton when 5 tons of dry pulp is passing through the flotation circuit. Now pass a straight line from 5 tons to "0.10" lb. reagent. The number of "c.c." per minute should read 10 times as large as the first reading. Repeat from 5 tons to "1.0" lb., and the reading should be 100 times as large as the first reading.

Check and recheck several calculations, and if the chart will stand the tests, it is ready for use. It is best to make a tracing of the work chart and have prints made for use in the mill.

From this chart, knowing any two variables, the third is found easily and accurately, by use of a straight-edge or piece of string. Passing the string over any two numbers known, read the third or required number immediately. I suggest that all unit divisions be divided into units small enough to meet any degree of accuracy desired.

This is one of the simplest type of alignment charts, where log divisions of the numbers are used. After this method of constructing an alignment chart is better understood, more complex formulas can be plotted easily and rapidly. The same general principles can be applied to making nomographic charts of other types. The ideas may be carried out to include the construction of doubled or folded scales to cover a greater range of values or make the readings more accurate. Charts having more than three variables may also be constructed.

The hardest part of making a chart of this sort is to picture the formula in its simplest form. One should make a rough sketch of the chart one may have in mind, picture the calculations to be made, keeping the limits of the factors in mind, and very soon the formula is ready to be plotted.

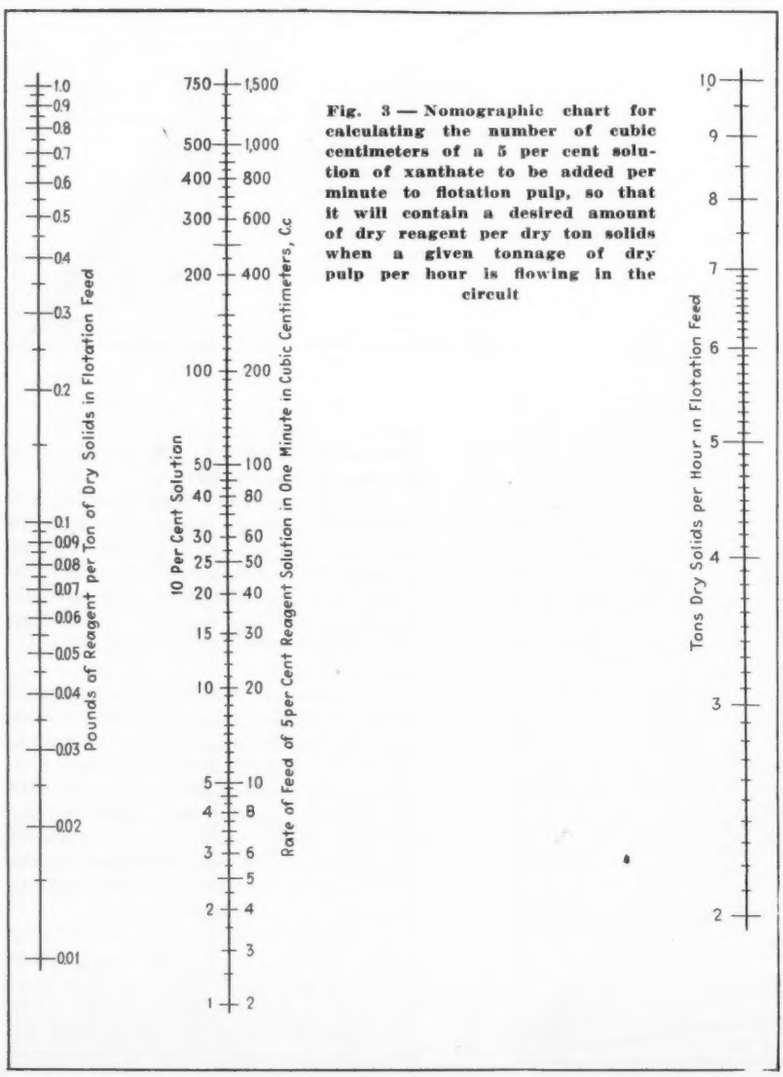


Fig. 3 — Nomographic chart for calculating the number of cubic centimeters of a 5 per cent solution of xanthate to be added per minute to flotation pulp, so that it will contain a desired amount of dry reagent per dry ton solids when a given tonnage of dry pulp per hour is flowing in the circuit

Mounting Concentrates and Tailings For Microscopic Study

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Up-to-date technique largely turns on use of suitable cementing material for polished surfaces and thin sections

MICROSCOPIC STUDY of concentrates and tailings has become an important part of the procedure in modern milling practice. To utilize the advantages of this method of study, however, the materials examined must be properly mounted. In many instances, little, if any, information can be secured by looking at ground products through a microscope unless they have been prepared previously by some satisfactory method of mounting. During the past two or three years a large number of samples of concentrates, tailings, and other crushed products have been prepared for microscopic study in the Mineralogical Laboratory of Columbia University. The methods employed have been developed to the stage where a uniform procedure yields satisfactory results with a wide range of materials, even when ground to minus-300 mesh. In view of the fact that an appreciable number of inquiries regarding these methods have been received, I feel that a published description would be of value.

Materials that have been satisfactorily mounted include crushed concentrates, tailings and middling products of a wide variety of ores, flotation concentrates of phosphates, disintegrated manganese ores, drill cuttings from oil wells, heavy mineral concentrates from sedimentary rocks, and the like. In addition, broken and badly decomposed material from crush zones in orebodies has been mounted.

Microscopic study of mill products thus mounted has proved useful in routine problems involving milling practice, as well as in others of a special character. Identification of both opaque and non-opaque minerals is made much more readily and with greater accuracy than by examination of unmounted material. A grain count or inspection of the ore minerals present may also give an approximate check on assays. The size to which an ore must be ground to separate it from gangue may be determined

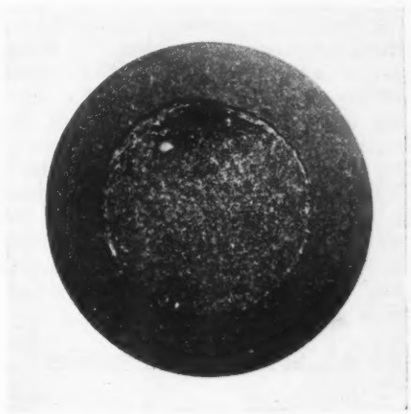
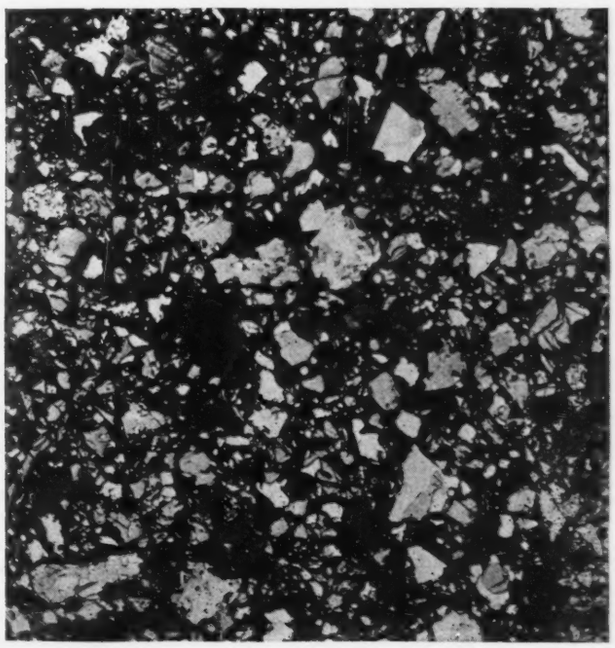


Fig. 1, center column—The top of a mounted blank (x 2) that has been polished for studying the opaque ore minerals. This blank was made by embedding a complex zinc ore concentrate screened to plus 100 mesh in Bakelite resinoid. The black area at one side of the blank is pure resinoid. The outer rim is Bakelite molding material. Photographs by Prof. P. F. Kerr, Department of Geology, Columbia University

Fig. 2, bottom, left—A part (x 200) of area shown in Fig. 1. Large grain in center is sphalerite with inclusions of galena and chalcopyrite (both white). Interstitial area Bakelite resinoid

Fig. 3, below—Photomicrograph (x 200) of the ore shown in Figs. 1 and 2, but crushed to minus 300 mesh. The gray fragments are sphalerite and the white galena and chalcopyrite. Note presence of occasional middling fragments even when crushed to this fineness



and minute intergrowths detected. Also, the cause of losses in tailings may sometimes be more readily located.

The method consists of binding the fragmental material in a cementing medium that will become sufficiently hard to permit grinding or polishing. This hardened mass, with the cementing matrix, forms what may be called a "blank." For the examination of the opaque minerals the blank is ground flat and subjected to a high degree of polish for study by means of reflected, polarized light. For the examination of transparent minerals a thin section is cut from the blank for study by the regular petrographic methods.

Efficient Technique Developed

Once the material has been mounted in the cementing medium, or matrix, it can be treated essentially the same as a rock for the preparation of a thin section or polished surface. A smooth flat surface is ground on the blank and cemented on a glass slide with Canada balsam. The material is then ground to a thickness of 0.03 mm., the standard thickness of thin sections, and a cover glass placed over it. The sections and polished surfaces can be labeled and filed for future reference.

In developing this technique considerable time was spent in finding a suitable cementing material for both polished surfaces and thin sections. Two general classes of such materials are available: (1) cements that are mixed with water or some other liquid, and become hard or "set" at atmospheric temperature; and (2) synthetic resins, which are hardened by heat-treatment, and once hardened are not affected by further heating unless at unusually high temperatures. The synthetic resins are more satisfactory, although slightly more difficult to handle properly. Of these, Bakelite resinoid No. BR-0014 is the best preparation that has been tried, and it has been used exclusively in the Mineralogical Laboratory of Columbia University for the past three years. It is inexpensive and easily obtained.[1]

Bakelite resinoid is marketed in the form of a red, sirupy liquid. With age or exposure to the atmosphere it becomes more viscous. Its viscosity may be reduced to the desired point by the addition of denatured alcohol when it becomes too viscous for use. Bakelite periodically thinned in this manner has been used with entire satisfaction for two years.

Bakelite hardens or cures in two distinct stages. The solvent, of which the chief ingredient is alcohol, is first driven off at a temperature below the boiling point of alcohol. A constant temperature of 75 deg. C. gives excellent results. The time required for this stage of the curing process depends chiefly on the thickness of the mass being treated; the thicker the mass, the more time required. A thickness of one-fourth inch will require about 24 hours. At the completion of this stage the sirupy, sticky material has lost its stickiness and become a gum-like mass possessing some resilience at 75 deg. C., but on cooling the Bakelite assumes greater firmness and partly hardens.

The second stage in the curing process may be carried out at any temperature up to approximately 125 deg. C. This stage merely hardens the mass and causes it to shrink slightly in volume. A mass one-fourth inch thick requires about 24 to 30 hours' treatment at 90 deg. to 100 deg. C. in addition to the first stage to cure enough for blanks from which thin sections or polished plates are to be made. When cured in this manner, it binds and grips fragments it may inclose with remarkable tenacity.

After curing, Bakelite resinoid is a hard, tough, red material that is transparent in thin sheets. It may be ground to any desired thickness without tearing, and it takes a high polish. In thin sections it is slightly yellow and, except for a narrow band encircling the grains it incloses, is isotropic. This rim shows a slight birefringence, apparently due to strains set up by contraction during the final stage of curing. The resinoid has a refractive index of approximately 1.63.

Blanks for Polished Surfaces

The method employed in making a blank for a polished surface differs somewhat from that followed in making a blank for a thin section. A blank for a polished surface is made by pouring the concentrate, tailings, or other crushed material into a suitable mold to a depth of about 2 mm. A 1-in. round or square cardboard box, such as a pill box, one-fourth inch or more deep, is entirely satisfactory for a mold and is easily secured. A sufficient quantity of Bakelite resinoid is then poured over the grains to fill completely the interstitial space between them, and, in addition, to form a layer a millimeter or so thick on top. The Bakelite will flow into the interstitial space without stirring.

A thermostatically controlled electric oven is used for the curing process. The mold with its contents is placed in the oven so it will be about level, and the Bakelite cured as described in the foregoing. Care must be taken not to raise the temperature for the second stage in the curing process until all of the solvent has been evaporated. To avoid this, the physical condition of the Bakelite is tested from time to time, and the temperature is not raised above 75 deg. C. until the mass has lost its stickiness and become slightly resilient when dented with the finger. Unless time is an important factor, it is not advisable to use a temperature above 100 deg. C. for the second stage in the curing. This stage can also be advisably discontinued while the Bakelite, at oven temperature, can still be slightly dented with the finger nail. Further curing may set up sufficient strain due to contraction to cause the blank to crack when it cools. The blank is allowed to cool slowly, and the cardboard mold ground off. It can then be mounted in Bakelite molding material[2] to facilitate handling, or it may, if more convenient, be polished without mounting.[3]

Blanks for Thin Sections

A satisfactory thin section cannot be made from a blank for a polished surface as here described. This is due to a tendency of the blank to warp slightly when it is heated for mounting on the glass slide, and results in a thin section of uneven thickness. To overcome this difficulty, the Bakelite must be cured on a piece of material that will not warp when heated. Double-thick window glass at least one-eighth inch thick has been found satisfactory for this purpose. The glass is secured from a glass fitter in pieces one inch square. One side is ground with No. 100 Carborundum on an ordinary rock grinding lap until it is thoroughly frosted. From three to eight drops of Bakelite resinoid are dropped on this frosted surface. For this purpose the Bakelite should be exposed to air until it is slightly more viscous than when fresh. The grains of the material of which a thin section is desired are then stirred into the Bakelite with a needle until almost all of the Bakelite is required to fill the interstitial space. If the mass consists of too much excess Bakelite and not enough grains, it will flow over the edge of the glass plate, and the result will be an unsatisfactory blank.

The plate is placed in the oven so that it is level, and the Bakelite cured as described in the foregoing, except that the second stage is carried out at a temperature not above 90 deg. C. The curing is stopped when the Bakelite can still be dented with the finger nail at this temperature. If excessively cured, it will contract and break loose from the glass when cooled. The mass of cured Bakelite and fragments forming one side of the blank is then ground flat and smooth and cemented to a slide glass with Canada balsam. The glass of the blank must be ground away, and then the Bakelite and grains may be ground to the desired thickness.[4]

[1]The Bakelite Corporation, New York, N. Y.

[2]Krieger, Philip, and Bird, Paul H.: "Mounting Polished Surfaces in Bakelite." *Economic Geology*, Vol. XXVII, 1932, pp. 675-678.

[3]For an excellent discussion of polishing technique, see Short, M. N.: "Microscopic Determination of the Ore Minerals." Bulletin 825, U. S. Geological Survey, 1931, pp. 10-17.

[4]An excellent outline of the technique used in making thin sections may be found in "Thin Section Mineralogy," Rogers and Kerr, 1934, pp. 3-7.

Blasting With Safety Primers

Their Use Practically Eliminates Explosive Accidents for the Metropolitan Water District of Southern California

Thomas Soule

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Industrial Indemnity Exchange,
San Francisco

THE SAFETY PRIMER is one in which the blasting cap is inserted in a cylinder or block of some non-explosive material such as wood, cement, or wax, the blasting cap being held in place with glue. It has also been referred to as an inert, non-explosive, or dummy primer.

The Rand district of South Africa was the first to use the safety primer, so far as is known. As the use of this primer proved successful from a safety standpoint when it was employed in connection with fuse blasting in South Africa, an Arizona copper mine raised the question as to whether or not the safety primer could be used for electric blasting. To determine this, the engineers at the property conducted some experiments about two years ago in which they replaced the live primer with the safety primer in their electrical blasting. So impressed were they with the safety, convenience, and saving of time obtained by the use of the safety primer, that they adopted it as standard practice in all their blasting operations. Inasmuch as fuse blasting has been supplanted by electric blasting at this mine, the only type of detonator in use is the safety electric primer. Therefore, the description which follows applies only to the electric type of safety primer.

The Delay Safety Electric Primer—This type of primer is used for all standard round blasting in drifts, shrinks, shafts, tunnels, and other workings. Delay detonators used are the 0, 1, 2, 3, 4, and 5 delays of No. 8 strength, of the all-metallic type. Safety primers are made up by inserting the blasting caps in wooden plugs and holding them in place with glue. The plug (see Fig. 1) is of quarter octagon shape, about ¾ in. longer than the longest delay blasting cap used, and is made from ⅛-in. material. Use of the quarter octagon shape allows room on the sides of the plug for the leg wires to pass. One end of the plug is tapered in the shape of the frustum of a cone, which makes it easier to push the primer into the hole. A saw mark, ½ in. deep, is made in this same end of the plug, through which the leg wires are brought back around the end of the plug, thus preventing the leg wires from coming in contact with the bare rock in the bottom of the hole.

The plugs are made from salvaged lumber on a machine specially developed for the purpose, the arrangement of which machine is shown in Fig. 2. The drill used for boring the hole is shown at *A*. A spoke sharpener has been attached to this drill in such a way that the hole is drilled through the plug and a taper placed on the end of it at the same time. Details of this drill are shown in Fig. 3. This drill is made in the machine shop by taking an ordinary ⅜-in. twist drill and grinding it down to the dimensions shown in the sketch. The tapered hole in the plug prevents the detonator from passing entirely through the plug, at the same time giving it a fairly snug fit. The dimensions of the plug and the hole through it would of necessity vary with the type of the delay electric blasting caps being used. A circular slotting saw 7 in. in diameter is shown at *B* (Fig. 2). This saw is fitted with guide and gage blocks in such a manner that it cuts a ½-in. slot directly in the horizontal diameter of the end of the plug. The letter *C* represents a cut-off saw fitted with guides and a gage so that it will cut the plug the required length. The drills and both saws are operated by the same motor through countershafts and friction pulleys.

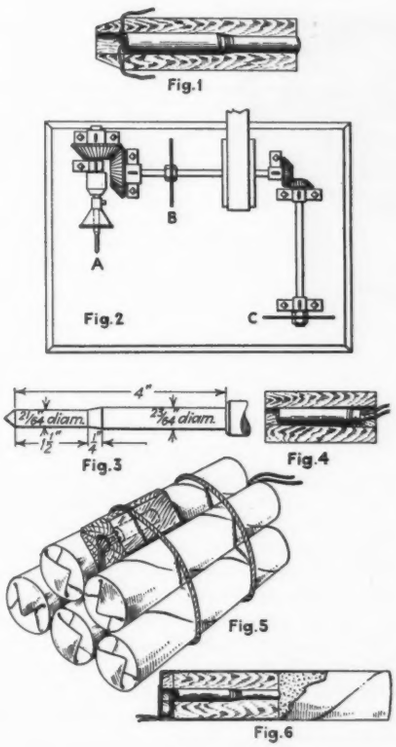


Fig. 1 — Quarter-octagon wooden plug for electric type of safety primer. Fig. 2 — Diagrammatic sketch, plan view, of machine developed for making plugs. Fig. 3 Detail of drill shown at A in Fig. 2. Fig. 4—Instantaneous electric safety primer, comprising cap and plug, longitudinal section. Fig. 5—Bomb made up with safety primer. Fig. 6—Special charge, made up with a safety primer, for block-shooting and similar applications

In making the plugs the following method is used: The lumber is first ripped into ⅛-in. square sticks about 5 ft. long. These sticks are then run through a rod machine set at 1 in. This cuts off the corners and gives the stick a quarter octagon shape. Next, the hole is bored and the taper placed on the end of the stick in the same operation. By touching the end of the stick to the slotting saw, the ½-in. slot is cut in the end; and, finally, the plug is cut off from the end of the stick the required length by the cut-off saw. As the plug is cut off, it drops through a hole in the bed of the machine into a container. The plugs are now ready for use in making up the safety primers.

The cost of the plugs varies, depending upon the grade of lumber used and the wages paid the man operating the machines. Salvaged timber has proved satisfactory for use in the plugs. One man operating the machine and preparing his own material can turn out about 1,200 delay type plugs in an eight-hour shift.

All safety electric primers are made up in the detonator magazine. The man formerly engaged in cutting and capping fuse now devotes his time to making up the safety electric primers. The live end of the blasting cap is dipped into glue for about half of its length and is then inserted in the plug until the live end of the blasting cap just comes

flush with the end of the plug. The leg wires are then brought through the slot, one on each side. All safety primers are made up at least 24 hours before they are to be used, so as to give the glue sufficient time to set.

The following procedure is used when loading a hole with the safety primer: The primer is always placed in the bottom of the hole with the live end pointing back toward the collar. A stick of dynamite is used to push the primer in the hole to avoid leaving an air space between the primer and the explosive and to eliminate the possibility of getting mud or rock between them. This also prevents the tamping stick from coming in contact with the end of the primer.

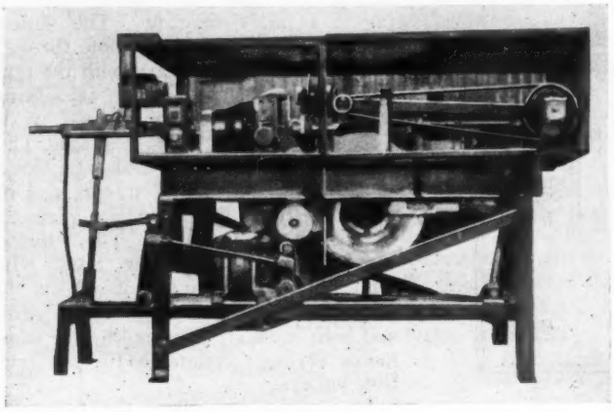
Before loading, the paper is unfolded from one end of the stick of dynamite and the live end of the primer is placed against the bare explosive. The stick of explosive, following the primer, may be split, and when dynamite and the primer have been shoved to the bottom of the hole, a firm push on the tamping stick will force the dynamite firmly around the end of the primer. This insures a good contact between the blasting cap and the explosive, and, at the same time, fills up some of the free air space between the safety primer and the side of the hole.

The Instantaneous Safety Electric Primer—This primer has found its greatest use in making up bombs to be used in mud-capping boulders, or for blasting down hung-up chutes or fingers. The wooden plugs are cut ½ in. longer than the blasting cap and are drilled with a special tapered wood bit, so that when the cap is glued in the plug it will lie ¼ in. from each end. The blasting caps used are of No. 6 strength. Details of the instantaneous safety electric primer are shown in Fig. 4. Both the instantaneous and the delay plugs are made on the same machine, but as no slot or taper is required with the instantaneous primer, these can be made more rapidly than those of the delay variety. One man can prepare the material and make about 1,800 instantaneous safety primer plugs in an eight-hour shift.

Making Up Bombs—The bomb in common use (see Fig. 5) is made up with an instantaneous safety electric primer as follows: The required number of sticks of dynamite are placed together and the safety primer is laid on top at one end, with the live end of the primer pointing down the bomb and the leg wires passing under the plug. This end is tightly tied with a string, the primer being tied in with the sticks of dynamite. The other end of the bomb is then tightly tied with another string, the leg wires of the primer passing out of the bomb under the second string. As one man can make up all of the bombs used in a particular locality, they can thus be made up in a standard manner.

For blockholing boulders, shooting out timber by means of shallow holes, or similar work, a special charge (see Fig. 6) is used. This is made by using a distinctive red paper shell 1¼ in. in diameter. First, a stick of 1⅛-in. explosive is cut in two, and one-half is placed in the paper shell with the bare explosive pointing up. A "0" delay safety primer is placed in the shell on top of the explosive with the live end of the safety primer in contact with the bare explosive. The leg wires pass out on either side through slots cut in the end of the paper shell. Then the paper of the paper shell is folded over the primer and the charge is ready to use. In using this special charge in shallow holes, the charge is placed in the hole last and is held in place by means of mud or tamping.

The special charge shown in Fig. 6 may also be used in preparing bombs, the charge being tied in with the bundle of dynamite. By this method the maximum effect of the blasting cap is utilized, as both the end and the side detonating force is effective. Where only a few bombs are being used daily, this system undoubtedly makes the most efficient bomb. However, when a large number of bombs are being used, the method of tying the safety primer to the side of the bundle of dynamite has the advantage that it is quicker to make up, it is unnecessary to cut any explosive, and the expense of the paper shell is eliminated. A record of the shooting of over 150,000 bombs similar to that shown in Fig. 5 was kept, and so far as could be found out, all bombs were exploded; this in spite of the fact that for this work an electric blasting cap of but No. 6 strength was used.



Machine built by the Metropolitan Water District of Southern California for the manufacture of safety primers. It is entirely automatic and turns them out at a rate of about one a minute

Advantage of the Safety Primer—The June, 1931, issue of the *Explosives Engineer* carried a description of the safety primer.[1] As the authors of this article have since received many inquiries, it may well be that the advantages of the safety primer can best be explained by answering some of these inquiries:

Question—What are some of the safety features of the safety primer?

Answer—No skewer is needed in making up the safety primer, and puncture wounds from this cause are thus eliminated. The safety primer is safe to transport, as the blasting cap is protected against shock, heat, and friction by its protective covering of wood. The safety primer is not as dangerous in broken rock as the live primer, the safety primer being protected by the wooden plug surrounding it, and should it explode, it will not do the damage that a live primer would.

It is absolutely safe to load, as the detonator cannot get crossways and be set off by friction with the side of the hole.

No explosive is left in the bottom of cut-off holes. As the safety primer is always placed in the hole first, any explosive left in a cut-off hole will be detonated.

A safety primer, when used in connection with a bomb, is protected from friction with the rock as it is placed in the chute, and should it become mixed with the broken rock, it is less likely to explode while the broken rock is being handled.

Question—Does the safety primer cause misfires?

Answer—A careful investigation has been made of the results of shooting a total of over 329,500 primers. Of this number, 152,700 instantaneous safety electric primers have been used to detonate bombs, and so far as is known there has not been a case where the safety primer has fired without detonating the bomb.

Of the remaining 176,800 delay safety electric primers, used as detonators in rounds, there has not been a misfire that could be traced to the safety primer, provided the round has been properly loaded. When the delay safety electric primers were first introduced, some misfires were found that could be traced directly to the safety primer. Investigation showed these causes to be due to: reversing the plugs in the holes; leaving an air gap between the end of the primer and the explosive; and not having the live end of the blasting cap

[1] "Electric Blasting Practice at Morenci Mines," by R. I. C. Manning and Thos. Soule.

come flush with the end of the wooden plug.

Question—Do rounds break bottom with the safety primer?

Answer—The safety primer has been used in ground of various degrees of hardness, from decomposed porphyry to quartzite, and the number of bootlegs or bottoms left after blasting have been no more noticeable with the safety primer than when the live primer was used.

Question—Is there a loss of efficiency due to having the blasting cap inclosed in a block of wood, rather than having it buried in a stick of explosive?

Answer—Engineers have proved by laboratory tests that the maximum effect of the detonator is developed when the entire detonator is buried in the explosive with the closed end pointing in the direction of the charge and lying as nearly as possible on the center axis of the priming cartridge. As a result of these conclusions, there is obviously a loss of efficiency through the use of the safety primer. However, under actual operating conditions, factors that help to minimize this loss of efficiency have developed. The following are some examples:

Conclusions

1. Tests have proved that the effect of a detonator is the greatest when the blasting cap lies in the longitudinal axis of the hole and the closed end points toward the bulk of the explosive. This ideal condition always exists in a hole loaded with the safety primer. Tests made by loading rounds in a mold with the live primer have shown that even when the live primer is carefully made it is difficult to keep the blasting cap in the longitudinal axis of the hole, and in nearly every case the closed end of the cap lies more or less at an angle.

2. The efficiency of the explosive in a drill hole depends to a great extent upon the amount of free air space left in the hole after loading. With the live primer, the primer itself is never tamped and the following stick is tamped only lightly, so as to avoid displacing the detonator in the primer. There is, therefore, a free air space around the live primer corresponding to the difference in volume between the diameter of the primer and an equal section of the drill hole at that point. The free air space around the safety primer occupies a much shorter section of the drill hole, and even this space is partly filled up with the explosive when it is forced around the primer at the time the hole is loaded. This is especially true when a yielding type of explosive, such as the gelatines, is being used.

3. Another important factor in the efficiency of a charge is the relative concentration of that charge in the bottom of the hole. As stated before, with the live primer, the primer itself is never tamped, and the cartridge immediately following it is tamped only lightly. In loading with the safety primer, every stick of explosive placed in the hole is split and forced firmly in place, thus giving a dense concentration at the bottom of the hole, where it is most effective.

4. At most metal mines, the amount of explosive given to a miner to break a certain class of rock is listed on a chart, which serves as a guide to the boss when he is writing out his explosive orders. In making up such a chart, it is customary to add at least 5 per cent to the theoretical amount, to compensate for unfavorable planes of weakness encountered and any slight deviation from the standard round by the miner doing the drilling. This 5 per cent, no doubt, has more than compensated for the loss of efficiency due to the use of the safety primer, as there as been no increase in the consumption of explosives since the introduction of the safety primer. After all, the manner in which a round is drilled and the variations in the character of the rock encountered probably have as much effect on the efficiency of the explosive as the difference in the initial detonating wave set up between a safety primer and a live primer

The accompanying photograph shows a machine built by the Metropolitan Water District of Southern California, at its Pushawalla camp, for the manufacture of safety primers. This machine is entirely automatic and turns out safety primers at the rate of about four a minute. I am told that the company has manufactured nearly a million of these primers.

All blasting done on the force account work is by means of the safety primer, and a number of the independent contractors are also using them, the Metropolitan Water District selling primers to contractors at cost.

At the last safety meeting of the Metropolitan Water District, which I attended, the safety engineer stated that previous to the use of the safety primers the Water District had sustained $36,000 in losses, owing to explosive accidents; since the introduction of the safety primer, the cost for explosion accidents has been less than $100, this owing to one of the miners getting an infection from a sliver while handling one of the primers.

Native Mercury in Mexico

W. Ernest Franks
Rayon No. 2, San Luis Potosi, Mexico

MANY discussions have centered about the occurrence of native mercury, and much doubt has been expressed at various times concerning the natural origin of some of these deposits. A peculiar occurrence that affords some interesting data relative to the genesis of native mercury is found in the State of San Luis Potosi, Mexico. The mine is on the brow of a steep limestone mountain at an elevation of about 1,000 ft. above a broad cultivated valley. Beds of shale occur in the limestone, and the dip of the strata is nearly the same as that of the surface of the mountain. Dense high brush and moss, indicative of a moist climate and constant rain, cover the mountain. An extensive outcrop, highly decomposed, of some igneous rock is found at the foot of the mountain.

The old workings consist of a number of pits and drifts along the strike of the shale bed, which lies from 10 to 20 ft. below the surface. These workings extend, more or less horizontally, for a distance of about 450 ft. along the side of the mountain. A few rises and overhand stopes exist, but no serious explorations were made downward along the dip.

The parting planes, fissures, and vugs of the limestone in the footwall of the shale are filled with white calcite and drops of native mercury, with some chloride, but the metal does not penetrate the body of the rock. The shale, varying in thickness from one foot to several feet, is highly decomposed; in parts just an earthy residue remains.

Without doubt the original cinnabar was deposited chiefly in the shale, which gave easier access to the mercury solutions than the massive limestone. Numerous samples were taken along this bed and panned, generally with negative results. Only where the decomposition was less advanced did I get a showing of cinnabar corresponding to 0.3 to 0.5 per cent Hg.

Thus, in a moist climate with frequent heavy rains, a bed of comparatively porous rock containing cinnabar is found lying close to the surface of a mountain covered with a dense vegetation. The conclusion is that surface water charged with organic acids percolated into the shale, decomposing this and the contained cinnabar, and setting free metallic mercury, which then worked its way downward into the crevices of the underlying lime rock.

Remains of old native furnaces are found in the brush. The mine not being in operation at present, I cannot say what this native metal-rock ore would yield when mined on a commercial scale. Assay samples taken in the usual way would, of course, give misleading results. Dense vegetation and the covering of humus have hindered the search for other shale beds.

Equipping the Shop at

With an Eye to Low Costs for Plant Maintenance

Frank W. Gravlin

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FOR THE PURPOSE of discussing shop equipment for small mines, the latter may be divided into two classes: those having an output ranging from 50 to 150 tons per day and those producing 200 to 400 tons daily. The former will be considered first.

The Blacksmith Shop — Usually the greater part of the blacksmith shop's work is the sharpening of drill steel. At small mines, especially those in a Latin-American country, sharpening costs are usually high and the sharpening is very poor. This is due to a number of reasons: the work is frequently done by inexperienced natives, supervision is incomplete, and the equipment poor. Because of this the small mine may often use detachable bits to advantage. One may safely say that, at least until natives can be trained, better results will be obtained from detachable bits.

With welding available, broken and cracked machine parts can be repaired and new parts built. By the aid of the newly developed abrasion-resistant metals worn parts can be built up with an extremely hard coating. With a capable master mechanic in charge, natives can be taught in about ten days to handle the arc-welder sufficiently well to make acceptable lap and butt welds. Further experience will make them expert enough to handle the most difficult work.

The Machine Shop — The principal tool in the machine shop is of course the lathe. If only one is deemed sufficient, it should be of the sturdiest construction and as foolproof in design as possible. A small, cheap, poorly built lathe, such as is often bought by managers interested only in keeping the cost of shop equipment down, is a very poor investment. Within a short time, it will be so badly worn that to do accurate work on it will be impossible.

• INDIFFERENCE to the mine shop, so often exhibited by shortsighted management and which may prove costly, directly or indirectly, in many ways, was the theme of Mr. Gravlin in an article that appeared in the February issue . . . And because the opportunities afforded by a well-equipped, well-managed shop are likely to be greater in Latin-American camps, where native mechanics' wages are lower and transportation costs higher than in the United States, he was led to discuss his subject from the viewpoint of a mechanical superintendent or master mechanic of a South American enterprise, a rôle that he had filled on several occasions . . . In particular he stressed the latent skill of native workmen, too often undetected by their superiors because of the latters' ignorance of Spanish . . . In the present article, Mr. Gravlin discusses the proper equipping of the shops at a small mine for economical and efficient work.

For this reason the blacksmith shop equipment can be limited to a forge, a blower, an anvil, and the necessary hand tools. With the addition of a large carborundum grinding wheel the greater part of the smith work necessary for repairs can be handled.

The Welding Shop—In spite of the prevalence of the practice of welding, many mines today either ignore or make little use of it. In even the smallest mine a single-position electrical welder will quickly pay for itself. Because of the fact that after the welding motor generator has once been brought in, the only additional supplies to be transported will be the electrodes, arc welding is preferable to gas welding in remote localities.

A well-built lathe will last so much longer that it will prove a good investment, despite its higher first cost. Because of the inexperience of the natives that will be using the lathe, the controls should be so interlocked that no damage can be done by operating them incorrectly.

Decision as to whether or not to buy a drill press will primarily turn on the question of cost. If sufficient funds are not available for a good one, it will be better to get along with a portable drill until more money is available. A ½-in. electric drill will handle most of the work done at a mine of the size now under consideration.

In short, the necessary machine tools for a shop of this size are: A lathe, swinging work up to 24 in. in diameter, with a 5-ft. bed; a ½-in. portable electric drill; an electric-powered grinder, taking a 6-in. wheel, for grinding drills; and the usual small measuring and hand tools.

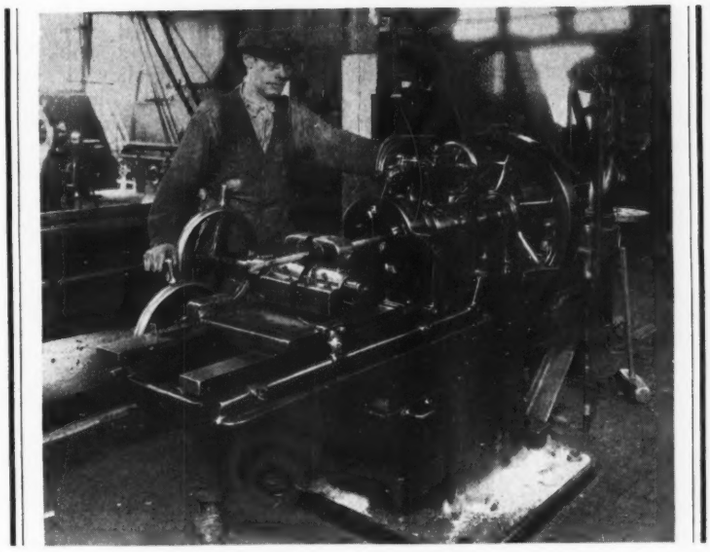
When the Mine Is Larger

We now come to the mine of a larger size, and here our problem is different. Before we were interested only in repairing. Now we find that actual manufacture of certain parts and equipment is advisable. In addition, the problem of training men to handle the various jobs without constant supervision presents itself. In the small mine this problem was not so important, because the master mechanic could give his individual attention to each job. At the larger mine he becomes more of an executive and teacher. The tools selected must not only be able to do the work required, but must be simple enough to be handled by natives. In addition, the manipulation of the controls, in so far as possible, must be such that unskilled labor cannot damage the tool itself by unintentional mistakes.

The Blacksmith Shop of the Larger Mine.—Because of the variation in the hardness and abrasive qualities of rock found in the same workings, it will often be found at the larger mine that steel sharpened at the mine will be much cheaper than detachable bits. Because of the larger amount handled, and the consequent opportunity this offers for securing the best sharpening and heat-treating equipment, together with a better class of blacksmith shop labor, a better piece of steel can be turned out than is likely to be produced at an extremely small mine. My experience has been that an intelligent native foreman will handle his steel in accordance with the type of ground being worked — an extremely hard bit for soft abrasive rock, a tough bit for hard rock. This flexibility cannot be had with most detachable bits, as yet.

Granting that steel is to be sharpened, little is to be said about the sharpeners. These are simple and can be operated by Indian labor. Tempering is another thing. The various color charts, magnets, and resistance glow-lights obtainable are all very nice, but they do not get steel tempered correctly with native labor. Pyrometer control of the forging and tempering fur-

Small Mines



A pipe-threading and bolt-cutting machine will be found useful in the machine shop of the small mine of say 200 to 400 tons' daily capacity. In many places it can be put to work reclaiming discarded pipe, with resultant saving

naces is necessary. This is readily applied to oil- or gas-fired furnaces. In many remote mines charcoal is still used. In such cases, the possibility of producer gas should be investigated, as this is a more efficient fuel than charcoal and much cheaper.

At the larger mine more work will be needed by mine and mill. Additional smithing tools will be required, but care must be taken not to fall into a common mistake respecting them. When all costs are taken into consideration it may be found cheaper to do the job by hand. This is true, of course, only where the necessary men can get at the job to do it. For instance, in Ecuador it is very much cheaper to move dirt by hand than to use steam shovels, unless the element of time enters. So in the blacksmith shop, it will be found cheaper to do light hammering by hand. However, a 500-lb. hammer will be cheaper on heavy work, this again due to the time element.

In general, the blacksmith-shop equipment will vary only from that of the smaller mine previously mentioned in the number of units. For instance, instead of one forge, four forges may be needed—and so on.

Gas Welding's Opportunity

The Welding Shop of the Larger Mine—The welding shop is one of the most important parts of the mechanical department. With the "putting-on" tool that mechanics of bygone days longed for, worn-out or discarded parts are given a new lease of life. In addition, hundreds of new objects can be made. The work done with the aid of welding equipment ranges from repairing the doctor's forceps to building a new foundry cupola.

At the isolated mine the electrical arc method of welding must take first place. However, opportunity will be found here for the oxy-acetylene outfit as well. Welding with the electric arc is primarily a shop operation. In mining, however, the oxy-acetylene method is of value because of the possibility of transporting the equipment to the job. For mill repairs and for the greater part of all new work the arc is best, but when the job is down in the mine, say on a cracked valve pot of one of the pumps on the 1,000-ft. level, the easily portable oxy-acetylene tanks and torch show their value.

If the mechanical department at the mine is being enlarged, the single-position machine can be put in the car shop and a new two-position set bought for the welding shop. In this way car bodies can be built and repaired without bringing them to the welding shop.

The oxy-acetylene outfit should be of the portable type that can be carried in a shoulder harness, and should be reserved for work which it is impossible or uneconomical to bring to the welding shop. By installing an inexpensive acetylene generator, only the oxygen tanks will have to be transported to the mine from the coast. With his equipment any welding or cutting job that will be met can be handled.

More Tools for the Larger Shop

The Machine Shop at the Larger Mine—In this larger shop, economy will justify the purchase and use of many more tools than were found advisable when only repairs had to be handled. Lathes to be used will depend, of course, on the type of mill and mine machinery installed. That is, the length of bed and amount of swing necessary will depend upon the dimensions of the parts it is intended to repair or make. Obviously, the installation of a lathe large enough to handle extremely large objects will not be justified if its full capacity is seldom used, unless the service features of the excess size are thought necessary.

Not only as regards lathes, but with respect to all machine tools, an estimate should be made of the actual time per day that each machine will be in use. A turret lathe might be useful for some jobs, but a study will show that the turret feature will be required on only a few occasions during the year. Again, the estimate may show that a turret lathe will, by saving time in set-up and tooling, soon pay for itself.

A large drill press or radial drill will be found very useful in handling repair and production work. Selection will depend upon the size of the material to be drilled, as well as the size of the drilled holes.

One of the most necessary machine tools, after a lathe, is a shaper. The usual cheap, badly designed shaper, with an extremely short stroke, is almost of less value than none at all. With a well-built shaper, however, a great deal of new and repair work can be handled, that would give difficulty otherwise.

For instance, a broken gear may tie up a very important machine unless replaced at once. No spare is available. It is on such an occasion that one's lathes, welding equipment, and shaper are necessary. A piece of shafting is welded to a circular steel plate and then this hub and shroud assembly is welded to a length of strap steel, formed in the blacksmith shop to the proper shape for the rim. Roughly turned to shape on the lathe, the complete assembly is placed on the shaper, and, using a segment of the broken gear as a templet, the teeth are formed. If time allows, the teeth may be heat-treated or the gear may be used just as it comes from the shaper.

Without the welding outfit and the shaper such a repair would be a tedious job, the choice being one of attempting a shaky repair of the broken gear or of making a rough patchwork by forming the teeth with a hammer and chisel and completing the job with a file.

When choosing a shaper not only the

construction of the tool should be studied but the size of work the shaper can handle. A shaper with a short stroke, though much cheaper than one with a stroke of, say, 20 in., is expensive, because of the need of resetting the work a number of times. Cutting keyways, slotting drive shafts, making plane surfaces on locations that are difficult or impossible to reach with a lathe, forming gear teeth, making gages and hand tools—all of these operations, together with many others, are jobs that can best be handled with a shaper.

Pipe Threader and Bolt Cutter Desirable

A power-driven bolt cutter or pipe threader is a tool the need for which is not always obvious. Any mine that has been in operation for some time has a large quantity of large- and small-size pipe that has been discarded but that can be reclaimed for electrical or surface work. Much of this pipe is bent and twisted, with the threads stripped or battered. In some cases there are small pinholes that render it useless for water or air service in the mine. It may be in such bad condition that less than half the length can be salvaged. In handling this salvage the pipe should first be inspected to determine what can be used in the mine after being repaired, what part must be used on the surface, and what is fit for electrical work. If the pipe has open seams or is too badly bent to be straightened it should be discarded. All pipe with a sound body should be straightened, the threads cleaned, or, if necessary, rethreaded in the pipe threader, cleaned, and, if the galvanized coat is broken, repainted with an enamel or asphalt coating. It is then ready for use.

Straightening of the pipe can be handled satisfactorily by hand, but the cutting and threading are best done by machine. A much more consistent standard of thread accuracy and squarer cut ends will be attained with the machine. Once this work is properly organized, it will be found that the bolt cutter will be kept in constant operation. An additional use for it will be found in threading long bolts and those of large diameter for special purposes in the mine and mill. Usually, one or two bolts can be threaded more cheaply by hand or on the lathe, but when a large quantity is needed for, say, shaft work, the bolt cutter is best.

When to Buy a Power Saw

The question of whether or not a power-driven saw is to be used depends upon the work to be done. If a great amount of pipe and rail is to be cut, a power hacksaw is advisable. Ordinarily, labor is so cheap that the use of the saw cannot be justified upon grounds of economy. If it is the practice to make tramway switches and crossings, however, as well as other work that requires an accurate cut, the saw may be necessary because of the difficulty of securing accuracy by hand-cutting. The saw should be so designed that it will be not only possible but easy to cut various metal shapes both straight across and at various angles. This is necessary in railway switch and crossover work and in cutting pipe for various welded connections.

Although this work comprises the only operation that justifies the installation of a power saw, I have seen various mines where it was impossible to handle this equipment. Such a failure may be due to structural weakness or to the fact that the saw is intended for straight cuts only. If only one saw is purchased, the one that will do the work required should by all means be obtained. The more expensive saw will do not only the work that can be performed as cheaply by hand labor but in addition those jobs that cannot be done as well by hand.

Drill Press vs. Radial Drill

Although holes can be drilled with the use of a lathe or by means of hand or electric-powered drills, and although this method is satisfactory for minor repair work, it is too slow for major repairs or production jobs. For such drilling some means of making large and accurate holes is needed. For this purpose a choice may be had between a drill press and a radial drill. As with other machine tools, the type selected depends upon the work to be done. With a drill press the work must be lifted up onto a table, whereas with a radial drill the work may be slid onto the table at floor level. The radial drill has the advantage that when the work has been fastened to the table all holes in the upper surface may be completed without moving the work, as the drill head can be moved in or out on the radial arm and the arm can be moved in a circle and up or down. This is most convenient when drilling heavy castings, as much waste motion will be saved and a more accurate job will be done.

The drill press is most suitable to small jobs or to those where only a single hole is to be drilled. If more than one hole is wanted, the dogs holding the work to the table will have to be removed and the work re-aligned. This consumes time and results in an inaccurate job unless care is taken. In every case, when natives are used, best results will be obtained if the work necessary to set up a job accurately is kept to a minimum.

Reiteration of the following statement is probably becoming boresome by this time, but it cannot be made too often: the radial drill is more expensive than the drill press, but it will do everything that the drill press will do and in addition many jobs that can be handled only awkwardly or not at all without its assistance. If it is bought for handling only a few exceptional jobs its value will be doubtful. If sufficient work, however, is to be available, the purchase will be much wiser than buying a cheaper drill press.

Respecting hand tools, such as wrenches, files, measuring tools, and taps, the wisest policy in general is to buy the best. Oftentimes only a single tool is available and its failure may result in loss because of the extra time taken or the inability to complete an important repair job.

An Apology

Before ending, a word of explanation may be advisable. It is not my intention to give advice to the men actually in charge of mechanical departments but rather to the managers of mines regarding the machine tools and work that are suitable for isolated mines in Latin America. Anyone who has shared my experience knows that the mechanical department is the stepchild of any company. This is not because of any intent, but because interest is concentrated on production, and all maintenance is regarded as a necessary evil the cost of which must be kept as low as possible. And to many the easiest way to keep the costs low seems to be to keep payroll costs and capital costs down.

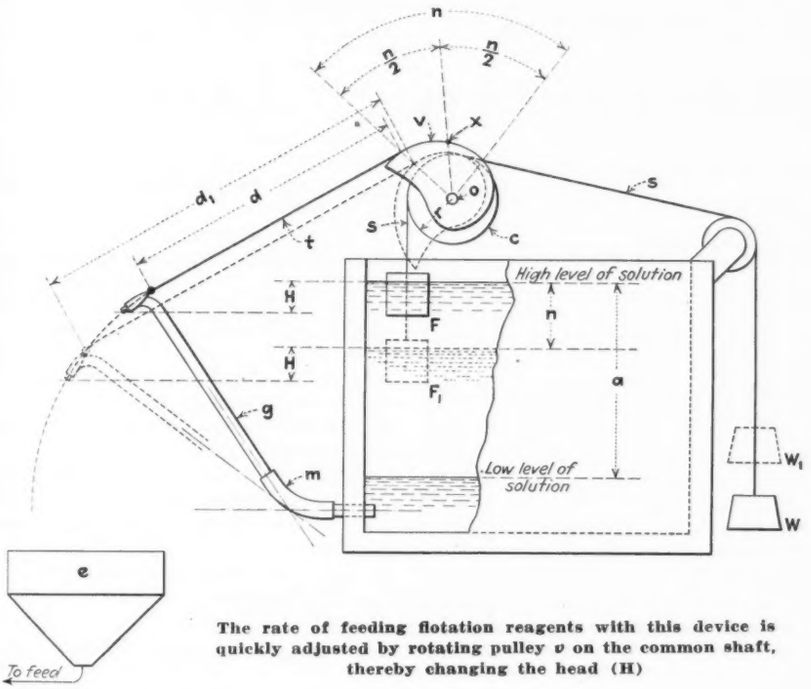
As any master mechanic realizes, to compare the advantages of two types of machine drills, technically and practically, would require a book, but if these paragraphs will make even one manager take an interest in his mechanical department they will have been worth while. If a manager will buy his mechanical department's equipment as he buys it for the mine and mill, on a basis of what it will do and how it will stand up rather than on a basis of first cost, maintenance costs will be lowered substantially.

Some years ago I was in charge of the mechanical and electrical equipment for a large oil company in South America. The total value of the equipment was well over a million dollars, and the machine shop boasted one hand-powered blacksmith's drill press and a combination surface plate and anvil made out of a piece of steel. A few hand tools completed the equipment. A few small mill-cut files were ordered from the warehouse, but the requisition was returned with the notation "No hay"—in other words "There aren't any." As there was need for these files a note was sent to the manager asking him to order a half dozen from the United States. It, too, came back with the opinion bluntly expressed: "I've been in the oil game twenty years, and I don't think there's any need of ordering all of these fine mechanical tools!"

A Corrosion-proof Reagent Feeder

Its Accuracy Proved by Prolonged Use—Rate Can Be Adjusted From 30 c.c. per Minute Up

ONE of the most annoying features of the operation of a small flotation plant in the past has been the difficulty of securing a cheap and accurate reagent feeder, free from the corrosive action of solutions. The unit illustrated was designed to fill this need, writes J. P. Lawyer, of Mina El Platero, at Ocatlan, Oaxaca, Mexico. Four of these feeders, operating in the flotation plant of the Platero mine for over a year, have proved absolutely accurate under all conditions and have given excellent service.



The rate of feeding flotation reagents with this device is quickly adjusted by rotating pulley *v* on the common shaft, thereby changing the head (H)

The cable (s), connecting the float (F) and the counterweight (W), travels over the circular pulley (c). Fixed on the same shaft with (c) is the involute pulley (v), on which travels cable (t) attached to glass tube (g). Tube (g) is connected to the outlet of the solution box with a piece of flexible tubing (m). It is readily apparent that, as the level of the solution lowers in the tank, the pulley (v) rotates in a counter-clockwise direction, correspondingly lowering the tip of the tube (g) and maintaining constant the head (H) for all solution levels.

Rate of feed can be accurately adjusted from 30 c.c. per minute to as great as desired by rotating the pulley (v) on the common shaft, thereby increasing or decreasing the head (H). All dimensions may be varied to meet individual requirements without affecting in any way the accuracy of the unit. The float (F) and the counterweight (W) should always be made sufficiently heavy so that the slight effect of the varying torque imposed on the shaft by the pulley (v) will be negligible.

A complete unit can be constructed by the average mechanic in a few hours from materials almost always at hand. The only feature which might cause some difficulty is the tracing of the involute curve of pulley (v), and the most practical way of accomplishing this is as follows:

In the drawing, (r) is the radius of the pulley (c); (n) is any increment of vertical difference in head and also length of arc on the circumference of (c); (x) is the required point on the involute; (o) the center of the shaft; (d) and (d_1) are lengths of the cable (t) measured to the same radial line at the beginning and end of the increment of travel respectively.

$$\text{Then:}\quad ox = \frac{r(d_1 - d)}{n}$$

As many points on the curve may be plotted as the accuracy of each case demands by increasing the number of the increments of the total difference in solution levels (a).

Solving a Grinding Problem

WHEN MILLING a pyrolusite ore the degree of hardness of which is 5 on the Mohs scale, difficulty was experienced in running continuously without choking the first mill of a two-stage unit, writes L. Millard, 2861 Memphis St., Philadelphia. Inasmuch as most of the impurities were in the fines, all minus-35-mesh material was removed at the outset from the discharge of the primary jaw crusher and only minus-2 plus 35-mesh material was fed to the mills.

Mill speed was above critical at the start of any one run, but after feeding for ten hours a gradual increase in power consumption would begin and continue until, at the end of thirty hours, the pulp level had reached a point where it was necessary to run for five hours without feed to free the mill of accumulated oversize and bring it somewhere near optimum speed.

The milling length of both mills was sufficient to give us a product of the specified 85 per cent minus-200 mesh continuously if the feed could have been reduced in fineness. Orders for this material did not warrant any changes in the preliminary grinding, but milling under the conditions described was also out of the question. The problem was solved by returning 10 per cent of the discharge from the secondary mill into the initial feed, increasing this to the stated extent. This flow of fines through the mills serves to carry with it all pieces of ore above optimum size, also reducing the percentage of large ore being fed to the mill. Incidentally, this method of feeding has reduced power consumption 25 per cent.

●

Cement Materials Beneficiated By Film Flotation

FLINT can be separated from the limestone in a cement raw material by agglomeration and tabling, according to a recent report (R.I. 3247) prepared for the United States Bureau of Mines by F. P. Diener, J. Bruce Clemmer, and S. R. B. Cooke. The stone is treated with small amounts of soap and oil, which produce an oil coating on the surface of the limestone particles and leave the flint surfaces unaltered. Following oiling, the ore is tabled. The flint is separated almost perfectly from the limestone. The size of particles for treatment should be between 6 and 65 mesh. Finer material may be cleaned more economically by froth flotation. The limestone from the concentrating tables has a lower flint content than is necessary for plant use. Consequently, the finer portion need not be treated, and flotation may be omitted.

NEWS OF THE INDUSTRY

Newly Mined Silver Commands 77.57c. by Presidential Proclamation

In Two Successive Steps, Two Weeks Apart, the Domestic Price of the Metal Is Increased From 64.64c. to 71.11c., on April 10, and Then to 77.57c. on April 24—Mexico Sends Treasury Official to Washington

BY VIRTUE of two Presidential proclamations, the Government's buying price for newly mined domestic silver was raised to 77.57c. an ounce on April 24. The proclamation establishing that price followed one made on April 10 that fixed the price at 71.11c. Necessity for the second proclamation developed when the world price of the metal advanced on April 24 to a level higher than that paid domestic producers. This last proclamation was the third made by President Roosevelt for the purpose of fixing the price of newly mined domestic silver, the first having been made on Dec. 21, 1933; this earlier proclamation (see p. 37, *E&M.J.* January, 1934) fixed the price of the metal at 64.64c. an ounce.

The text of the President's proclamation of April 24 increasing to 77.57c. the price that the Treasury will pay for newly mined domestic silver reads as follows:

By the President of the United States of America:

A PROCLAMATION.

Whereas by proclamation of the twenty-first day of December, 1933, as modified by proclamations of the ninth day of August, 1934, and the tenth day of April, 1935, the United States coinage mints are directed to receive for coinage and addition to the monetary stocks of the United States silver mined subsequent to Dec. 21, 1933, from natural deposits in the United States or any place subject to the jurisdiction thereof; and

Whereas such proclamation as so modified is subject to revocation or further modification as the interest of the United States may seem to require;

Now, therefore, finding that the interest of the United States requires further modification of said proclamation of the 21st day of December, 1933; by virtue of the power in me vested by the act of Congress cited in said proclamation, and other legislation designated for national recovery, and by virtue of all other authority in me vested;

I, Franklin D. Roosevelt, President of the United States of America, do proclaim and direct that with respect to all silver received by a United States coinage mint under the provisions of the proclamation of the 21st day of December, 1933, which such mint, subject to regulations prescribed hereunder by the Secretary of the Treasury is satisfied has been mined on or after April 24, 1935, from natural deposits in the United States or any place subject to the jurisdiction thereof, the deduction for seigniorage and services performed by the government shall be 40 per cent, and there shall be returned therefor in standard silver dollars, silver certificates or any other coin or currency of the United States, the monetary value of the silver so received (that is, $1.2929 plus a fine ounce) less such deduction of 40 per cent.

Notice is hereby given that I reserve the right by virtue of the authority vested in me to revoke or modify this proclamation as the interest of the United States may seem to require.

In witness whereof I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the City of Washington this 24th day of April, in the year of our Lord, nineteen hundred and thirty-five, and of the independence of the United States of America the one hundred and fifty-ninth.

FRANKLIN D. ROOSEVELT.

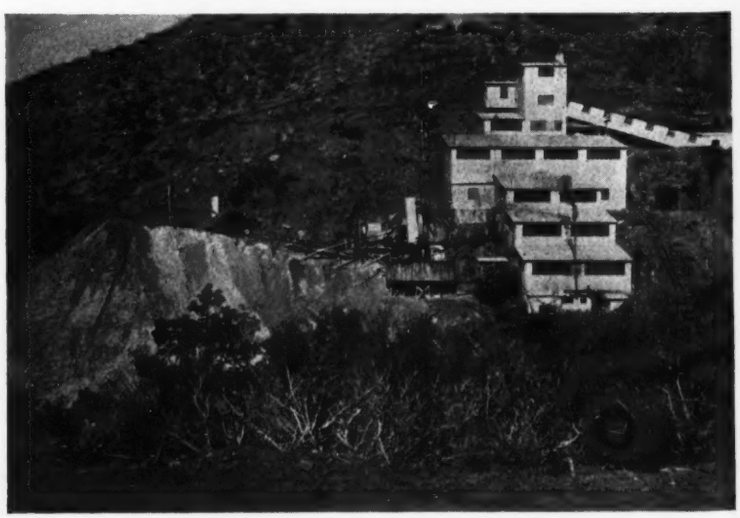
By the President:

Cordell Hull,

Secretary of State.

Monetary troubles in Mexico, born of world silver prices soaring after

• Milling plant of Boriana Mining at Yucca, Ariz., 70 miles south of Kingman. Current operations are on an increased basis, compared with those of last year, when nine carloads of tungsten concentrate were shipped. Recent mill improvements include a new thickener, a flotation unit, and a filter



United States Treasury offers on April 28, were taken directly to Secretary Morgenthau by representatives of the southern republic, according to Associated Press dispatches.

For an hour President Roosevelt's first financial adviser conferred with Ambassador Castillo Najera and Roberto Lopez, Assistant Secretary of the Mexican Treasury, who was sped to Washington by his government when climbing silver prices forced orders for the surrender of silver coins and closed banks over the week-end.

With Mr. Morgenthau were Herman Oliphant, the Treasury's general counsel, and Herbert Feis, economic adviser to the State Department.

Officials of neither nation would discuss the meeting beyond indicating further conferences. But before the session, Mr. Lopez said "it would seem proper that both countries should find a way to cooperate in this matter."

Many Large Companies Expanding Operations in United States

Calumet & Hecla Examining Gold-Bearing Areas Near Ishpeming, Michigan—Eagle-Picher Lead Acquires More Claims at Ruby, Arizona—U. S. Smelting Reopens Eagle and Blue Bell Mine—Zinc Industry Protests Code

HIGHER PRICES for silver have apparently further stimulated the flow of capital into precious-metal ventures. The larger companies, particularly, have become active in acquiring such holdings. Eagle-Picher Lead, for instance, which is operating Montana Mines, at Ruby, Ariz., has purchased an additional group of twelve claims, situated near by, following a careful sampling of the ground during the past six months. United States Smelting, Refining & Mining is reopening its Eagle and Blue Bell property at Eureka, Utah, and reports making a rich strike at the Toughnut mine, in the Tombstone district of Arizona, which property the company is operating under lease. Calumet & Hecla Consolidated Copper, besides reopening the Ropes gold mine, near Ishpeming, Mich., is making a thorough geological examination of the gold-bearing deposits in that district.

The American Zinc Institute's Committee appointed to "submit, modify, and approve a Code of Fair Competition for the Zinc Industry" addressed a letter to the National Industrial Recovery Board, under date of April 6, 1935, in which important questions were raised that affected the Code approved in Washington on March 26, 1935.

Pending clarification of Paragraph (g) of Section 6 of Article VI, with respect to control of production through voluntary agreement or otherwise, the Industry, the letter states, "does not acquiesce in said Paragraph (g) and will not be bound thereby." The Committee finds it difficult to construe this clause and requests that the Advisory Board give its interpretation of the phrase "or otherwise."

Subparagraphs of Section I of Article VII have been relettered, the Committee notes, which raises the question as to whether reports on production, shipments, and stocks are to be furnished to the Code Authority by the members of the Prime Western division only, as originally intended. The Industry, according to the letter, will proceed upon the assumption that reports requested are to be made only by the Prime Western group.

The Code as submitted contains the averaging provisions for labor which the Industry considers essential and necessary. The Industry is willing to accept the 60-day provision contained in the Order, but subject to the condition that in the event such averaging provisions are stayed as provided in the Order, or are modified in a manner not satisfactory to the Industry, the Industry shall not feel bound by the Code and will not acquiesce therein. Prior to the expiration of the 60-day period, the Industry will submit to the Board evidence to sustain the necessity and desirability of the averaging provisions to the employee as well as the employer.

The survey provision of Subparagraph (a) of Section I of Article III, with reference to the eight-hour day, is accepted subject to the condition that if any change in the wage schedule results therefrom the Industry will not acquiesce in such change nor feel bound by the Code unless the Industry in the district affected shall agree to such change.

B. N. Zimmer, Howard I. Young, John A. Robinson, and Ralph M. Roosevelt, chairman, signed the letter.

A summary follows of the more important news events that occurred in the various mining areas during March.

CALIFORNIA

• Delta Tailings Company, a new concern headed by E. M. Hamilton, S. E. Woodworth, and F. A. Beauchamp, of the firm of Hamilton, Beauchamp & Woodworth, San Francisco, and associates, plans early erection of a large cyanide plant 4 miles southwest of Ione, to re-treat gold-bearing tailing from the Amador gold mines that was carried there by Jackson Creek prior to 1904.

German Bar Gold Mines has completed the installation of a 35-ton mill at its property on the Middle Yuba River in Nevada County and will start production as soon as weather conditions permit. The company is headed by Col. C. R. Blood and T. E. Stephens, of Sacramento.

Unwatering operations have been started at the Sweet Vengeance mine, at Browns Valley, Yuba County, by Aladdin Gold Mining, organized recently to operate both the Sweet Vengeance mine and the near-by Pennsylvania mine. The unwatering will make possible a comprehensive examination of the property. Consulting engineers Oscar H. Hershey, of San Francisco, and Albert Burch, of Medford, Ore., have been engaged to explore the mines thoroughly and estimate the amount of commercial ore available. Their findings will determine the size of the mill the company plans to erect in the near future. Diamond drilling is in progress in the Pennsylvania mine under the direction of J. C. Vint, superintendent.

Milling operations have been resumed by Kennedy Mining & Milling, at Jackson, with twenty stamps in operation for the time being. Its neighbor, the Argonaut, plans to have 60 stamps dropping as soon as the 6,000-ft. level has been unwatered. Central Eureka, at Sutter Creek, plans to extend a drift into the Wildman and Mahoney property, just north of the Central Eureka holdings, for development purposes. The mill is treating 75 tons of ore a day, with twenty stamps in operation. Eighty men are employed under the direction of James Spiers, general manager.

Following a thorough examination of its property in the Middle Buttes, near Mojave, by Major Julian Boyd, consulting engineer, of Los Angeles, Kimball-Kempe Syndicate is sinking the 60-ft. shaft to 100 ft., as a preliminary to extensive lateral work to be undertaken upon completion of sinking operations.

The contract for the erection of a 1,100-ton cyanide plant on the Yellow Aster tailing at Randsburg has been awarded to the J. E. Knapp Company and the Western Machinery Company, both of San Francisco, by Anglo-American Mining, owners of the Yellow Aster and Big Dyke mines. The plant

will treat both the tailing from the large dump, acquired recently, and ore from the mine. Excavation for the equipment and tanks has been started, and the plant is expected to be in operation in August. The new project involves an expenditure of $175,000. Hamilton, Beauchamp & Woodworth, of San Francisco, are the consulting engineers, and Roy Marcellus is in charge of construction.

The new 16-cu.ft. twin-stacker gold placer dredge erected by the Natomas Company at Salsbury, about 6 miles west of Folsom, has started production and is reported to be operating satisfactorily. Monthly production is estimated at from 1,200 to 1,600 oz. of gold.

A 200-ton flotation plant has been completed at the Black Bear mine, at Grass Valley, a Cooley Butler subsidiary, and production is to start within 30 days. Development at the mine consists of a 1,000-ft. tunnel, known as the Schroeder tunnel, and underground work done by lessees. L. S. Wincapaw is in charge of operations.

According to a report from Los Angeles, Harley A. Sill, metallurgical engineer, of Los Angeles, is designing a mill to re-treat 350,000 tons of tailing available at the Kelly mine, near Randsburg, which amount does not include the 80,000 tons of tailing at the Kelly mill. When completed, the plant will have a capacity of 200 tons of tailing per day.

Milling capacity is being increased about 50 per cent at the Surcease mine, at Yankee Hill, Butte County, by the addition of three sand tanks and a slime agitator. The present mill is treating about 35 tons of ore a day. The company also plans to install additional concentrating equipment and a small concentrate treating plant. Hoefling Brothers, Inc., of Chico, Calif., owns the property, and A. E. Jones, superintendent, is in charge of operations.

ARIZONA

• The historic Silver King mine, near Superior, has been reopened after a fifteen-year period of inactivity. Discovered in 1873, the mine produced more than $10,000,000 over 50 years. A group, headed by B. Gays, of Superior, is sinking a shaft to the orebody. The higher price for silver has also led to the rehabilitation of Apache Silver, shut down in 1930. The 200-ft. shaft has been retimbered to the 160-level, crosscutting and drifting have progressed on the 105 and 160 levels, and the surface equipment has been replaced. A body of ore developed on the 105 level will be shipped to the Magma smelter. Reopening operations are under the direction of H. S. Bach.

Ajax Mining, at Arivaca, has completed a ten-stamp mill, with concentrating table and flotation unit. A tunnel is being driven to connect the lower workings with the mill.

Increased activity in the Oatman district has resulted in the Tom Reed payroll reaching a higher figure than ever before. Ore mined on company account is reported to be increasing in value at depth. Gold Road is trucking ore that is being mined on the 800 level from an area formerly cut off by a cave. Oatman Eastern is shipping increased tonnages from the Ruth-Rattan mines, with a new orebody discovered on the 200. Ben Harrison shaft at the Reed is to be deepened following unwatering.

World's Fair mine, at Patagonia, will be operated if the consent of a federal court is obtained for the receivers to accept the offer of Grover Marstellar, of Nogales. Adjoining this mine is the Chief, under development by Consolidated Arizona Copper Mines, at which a vein of lead-silver ore was cut by the 140-ft. shaft. This company is also operating the Molly Gibson, near the Mowry, in the same district.

A bill has been introduced in Congress that provides for the purchase of the claims of Northern Arizona Lead & Zinc Mining, located in Grand Canyon, as a part of the National Park. W. I. Johnson, president, is quoted as objecting to relinquishing the vanadium deposit.

A rich strike on the 400 level of the Toughnut mine, in the Tombstone district, has been reported by R. T. Walker, superintendent for United States Smelting, Refining & Mining, lessee of the property.

A 100-ton amalgamation plant is planned for the placer property near Gleeson by Sigler, McConnell, and Christensen, who have leased 100 acres for development.

Eagle-Picher Lead, operating Montana Mines, at Ruby, has purchased the Austerlitz and Andrews group of twelve claims, 2 miles west of the Montana, from A. H. Noon. The property has been held under option for sampling during the past six months.

Telluride Mining, at Oatman, operated by J. L. McIver, is sending 30 tons of ore a day to the mill. Big Jim, which has leased the mill, is treating an equal amount from the 660 level.

Gold Eagle Mining & Milling is installing a 25-ton mill to handle the output of the Red Horse claim at Camp Verde.

Scott Lode Mines has been incorporated to operate a gold mine at Quartzsite; the ore is to be treated in a mill on the Colorado River.

Mill tailing and the mine dump of the old Congress mine, at Congress Junction, have been acquired by the firm of W. S. Wasserman, of Philadelphia, which will operate on the property as the Congress Arizona Mining & Milling Company.

The Warning brothers report discovery of a ledge 1,000 ft. long and 300 ft. wide near Oatman, which they have named Flowing Gold.

An $8,000,000 deed of conveyance, recorded in Yavapai County, transferred the mine and property of the United Verde Copper Company to Phelps Dodge Corporation.

KAN.-OKLA.-MO.

• With the coming of fairer weather, the output of zinc concentrate from old tailing dumps in the Tri-State lead and zinc district has climbed upward and bids fair to reach a new high for the history of the field in the present summer. Twenty-one tailing mills are operating in the field, with an average

(*Continued on page 251*)

• Two modes of transportation at the Agua Fria mine, near Danli, Honduras. The tri-motored plane shown makes two flights daily between San Lorenzo, on the South Coast, and the mine, bringing in all equipment and supplies used at the property. It has a specially reinforced fuselage and a loading hatch. The normal load is two tons

NEWS FROM WASHINGTON

By Special Correspondent

STARTING with an inquiry on tin-plate scrap exports to Japan, a special House of Representatives committee has worked itself up to a legislative enthusiasm sufficient to recommend the creation of a "Board for Strategic Materials." This agency, as proposed, would consist of two Senators, two members of the House, and one representative each from State, Army, and Navy departments. It would have authority to make studies, formulate recommendations of policy, urge the President to promulgate rules and regulations, plan for mineral-resource development, and do industrial research on substitutes for strategic metals.

More sweeping legislation of vital concern to the mineral industry has never originated from a more inconspicuous cause. Originally, the special House committee was supposed to determine why the Japanese were buying tin-plate scrap. It was well known elsewhere, and presumably the committee soon learned, that the Japanese wanted the particular grade of scrap iron which the plate yielded on detinning, and that the tin was a minor consideration. But the tin investigation proceeded apace, and a volume of 1,100 pages is now issued containing the extended record of the hearings and an elaborate statistical report, with recommendations, all as a part of the evidence in support of the proposed bill (H.R. 7675).

New Mineral Policy

THIS proposed legislation rather steals the spotlight from the prospective final report of the Planning Committee for Mineral Policy, which report is now scheduled for completion in midsummer, slightly later than previously forecast in *E.&M.J.* The new proposal, if enacted into law, would do away with the earlier plan for a mineral-policy agency and ignore the National Resources Board ideas. It would also place in the hands of a mixed political-military group the responsibility for all studies, including technical and economic investigations, which latter responsibilities now in large measure rest with United States Geological Survey and Bureau of Mines.

Proposed appropriations are $375,000 per year, of which $175,000 would be used for each of three years in making a detailed tin-resource survey. The balance, $200,000, for each of five years, would be used in "a thorough and comprehensive study, survey, and research devoted to the exploration for and development of substitutes for tin."

One of the highest hurdles which this proposal is likely to meet in Washington is the question as to why this type of work should not be done by existing Government bureaus. And industrial executives, especially of tin-using industries, are expected to be very critical of the accompanying proposal of a duty of 6c. per pound on metallic tin contained in all imports which is to be imposed whenever the President finds that "mines of the United States are producing normally at the rate of ore equivalent to 1,500 tons of metallic tin per year," or if, despite no production, the President finds that "the imposition of such tax will tend to carry out the policy of the act."

Domestic Strategics

AN additional department, that of the Navy, has also entered the lists seeking funds to promote domestic industry producing deficiency minerals. It requested as a part of this year's appropriations an additional allotment of $20,000,000 to be added to the Navy Supply Account Fund, permitting contract for delivery from domestic sources of those deficiency metals and minerals which the Navy would like to have in reserve stocks. The Appropriations Committee has recommended immediate appropriation of $7,500,000 for this purpose. It is explained that if this item is approved in Congress, "The Navy Department therefore will request proposals for their estimated reserve requirements of these various strategic materials, exclusively of American production, specifying a delivery date sufficiently far in advance to enable domestic bidders to install such equipment as may be necessary and enter production. The committee is assured that if reasonable proposals are not tendered, awards will not be made and no further action taken until the matter can be laid before the next Congress."

Strangely enough, among the metals discussed in Washington likely to be so developed are aluminum and magnesium, as well as the more commonly noted strategic tin. This part of the discussion, however, sounds a good deal like anti-Mellon propaganda to catch Democratic support.

More Money for the Bureau

More mineral mining investigations are assured by the passage of the Interior Department appropriation bill, which gives the Bureau of Mines $553,000 more for its work during the next fiscal year than it had for the current fiscal year. Practically all of the increase will be spent in the field in an effort to aid the industry in taking full advantage of favorable conditions for the production of gold and silver. There will be new studies of the problems of mining iron and various non-metallic minerals. Each of the eleven experiment stations will receive additional funds. In addition, there will be increased work on health and safety problems.

The exact character of the studies will not be determined until the matter has been discussed with the advisory board, which will have its second meeting about June 1. It is expected, however, that the recovery of gold and silver from complex ores will be one of the major studies. There will be a special investigation of the problems of the small operator.

Pope Mining Bill

STILL on the Senate calendar is the proposal that the Bureau of Mines be given $100,000,000 to go into the business of mining gold, silver, and deficiency minerals. The Pope bill which contemplated this delegation of authority (S. 1476) was favorably reported to the Senate in mid-March and is now being studied for further amendment. The fact that a large part of the activity contemplated in the bill can be done without new legislation, by using money from the work-relief fund, makes enactment of the measure much less probable. Bureau officials have been discreet as to their interest in this measure; but it seems likely that they do not altogether favor the delegation of authority which would make them actual mine operators.

A recent meeting of the Bureau's Advisory Board, made up of more than a score of distinguished engineers and economists, strongly endorsed the fact-finding function as that to which the Bureau should limit its work. It went definitely on record as opposing the granting of police power to the Bureau, recommending as the only increase in authority a statutory right to require statistical reports from companies for confidential use of the Bureau when such reports are essential to the economic and statistical investigations properly undertaken.

Secondary Metals

OUTSTANDING among the projects likely to be investigated soon by the Bureau of Mines is the study of scrap and secondary metal. Since the resources are those of industry, not of natural occurrence, this project will be centered in the Economics Branch of the Bureau. Objectives sought will be facts on which industrial programming may be based for price stabilization and perhaps even for reduction of international friction.

The Bureau of Mines work is also to be augmented by the transfer of the

Minerals Division from the Bureau of Foreign and Domestic Commerce, effective July 1. Final enactment of a law to this effect has not taken place (May 2); but both houses of Congress have approved the transfer, which virtually insures accomplishment.

In planning its work for the next year, the Bureau is confronted by insistent desire on the part of members of Congress for decentralization. This influence has in the past been limited to insistence on many field stations for the experimental laboratories and engineering investigations. Now, however, there is clear evidence of desire on the part of certain Congressmen to distribute the economic investigations, a desire which the Bureau apparently has thus far successfully resisted. Since there are relatively few persons engaged in this work, and most of the facilities required for their studies are in Washington, it is expected that no change in policy will need to be adopted.

Silver

A SHARP RISE in silver price followed by a decline roused the suspicion that the Treasury was using the stabilization fund in part for controlling the world market. The influence of Government buying on price rises is unquestioned; but it is doubtful whether sales of silver have been made by the Treasury. That the Treasury is seeking an opinion on the legality of such sales by the Government is definitely known in Washington. Certainly there is no evident authority for selling silver once it is purchased under the present law.

That the Treasury wants to control the price is not doubted, for the lower the price at which purchases can be made the greater the "profit" when ultimate accounting time comes. Also the greater "inflation" influence.

The Western bloc of Senators and Representatives from mining states most conspicuously successful in silver are using their dominant position in many legislative matters. If certain departments of the Government dared be frank they could tell tales regarding trading imposed by this Western group which would make interesting, if not encouraging, reading. As one observer says, "This Western bloc will block anything if thereby it can get more bacon for the home folks."

NRA Extension

CONTROVERSY continues at the date of writing (May 2) as to what the Administration is going to insist on with Congress as to the extension of NIRA. The President, according to reports, has been almost persuaded to agree with Congressional leaders who wish to pass merely a continuing resolution extending that act ten months or a year longer, with substantially no changes. Donald Richberg, one of the most potent advisers at the White House, has opposed this, insisting on a new act which would clarify present controversies and reinforce New Deal plans for industrial regimentation.

Mixed motives are involved. Richberg and the other lawyers clearly recognize that if the old act lapses and a new act is substituted, most pending court cases become moot. New court cases would have to start afresh in trial courts and would, therefore, not reach final adjudication, with danger of Supreme Court reversals of New Deal ideas, for many months longer. Critical Washington believes that this possibility of delaying any final court decision which would interfere with NRA activities is the major influence back of the Richberg insistence on a new law.

Strangely enough, business men are more and more demanding that NIRA be extended so that certain parts of code activity can be continued without interruption. In this they support the New Dealers at least in part. But objectives are wide apart, especially when questions of price fixing arise. In that field the President, NRA officials, and Congressmen seem to agree that restriction of price controls must be insured before the present act is extended or a new act substituted. Mineral industries are, however, something of an exception.

In support of distinctive treatment for mineral industries, Dr. C. K. Leith, as chairman of the Planning Committee for Mineral Policy, made a specific recommendation to the Senate Finance Committee last month. He urged that special authority be given to grant price-control code rights to those industries engaged in extraction of limited natural resources, whenever the President finds "(1) that unregulated competition has caused and will cause serious waste of an irreplaceable resource; (2) that stabilization of supply and demand by control of production, price, and capacity will aid in reducing waste; (3) that the proposed code contains such additional provisions for the improvement of technical standards and the elimination of wasteful practices as seem to him reasonably attainable; and (4) that the proposed code contains provisions for fixing maximum prices, if necessary, by public authority sufficient to protect consumers from unreasonable advance in price."

Tariff Problems

BILATERAL trade agreements are far more difficult to negotiate than the President or the State Department anticipated. All the troubles of tariff making now center at the White House and with Secretary of State Hull. And they are legion. These gentlemen, being of political experience, more than ever before realize that any decision they reach offends so many as to make no decision preferable for many commodities.

Although the Administration apparently does not regret its Brazilian-treaty cut in the manganese tariff, the commotion which followed the announcement of that action has been sufficient to label all other mineral commodities as dynamite. Even other strategic metals of almost wholly foreign origin continue in the dangerous category. Repercussions from the grant favoring iron and steel imports from Belgium are also disquieting to the Administration.

The recent events with respect to tin, discussed in a preceding paragraph, show why even that metal cannot be made one on which the United States will promise not to raise the duty during the life of a trade agreement. And in this connection it should be recalled that oftentimes promises not to change duties become just as important items for trading as do actual changes in tariff rates.

The President has made perfectly clear his intention of continuing most-favored-nation treaties for the present. This means that any tariff adjustment made in one trade agreement negotiated with a single country takes effect for substantially all of the other important nations of the world. An elaborate statement released by the Department of State during April stressed this feature because of the fact that certain Belgian concessions contemplated were provisional or of limited duration. However, in that announcement it was made clear to other nations which discriminate by quota or otherwise against exports from the United States that they might be cut off from our list of most-favored-nation friends. At the time this was taken to mean that the President intended to use in full his power of actual horse trading with tariffs. But domestic matters have since been so pressing that there has been little evidence of action to reinforce that gesture.

Small Industries

IN AN effort to quiet the talk that Alphabetic activities are detrimental to small concerns, Secretary Roper asked his Business Advisory Council for comment. Mid-April release of an anonymous report on this subject emphasizes the very important part of credit for small enterprises in maintaining a balanced business situation. And the final paragraph of the release states:

"The Council strongly recommends an immediate study by the Reconstruction Finance Corporation, Federal Reserve Board, and Securities and Exchange Commission in cooperation with the investment bankers of the country, to the end that facilities be offered sound small industries for the acquisition of needed capital."

Most observers believe that further attention will be given, but doubt if it can mean anything of great importance for the small business man. The Santa Claus program of Congressional appropriation for specific relief purposes is an alternative all too likely to result.

American Zinc Institute Elects Howard I. Young President

Succeeds Ralph M. Roosevelt, Who Has Been President for the Past Five Years—E. V. Gent Appointed Secretary—Need for Cooperation Stressed at Annual Meeting Held in St. Louis on April 22-23

HOWARD I. YOUNG, president of the American Zinc, Lead & Smelting Company, was elected president of the American Zinc Institute at the seventeenth annual meeting of the Institute held in St. Louis on April 22-23. Mr. Young, who had been treasurer of the organization since its formation nineteen years ago, succeeds Ralph M. Roosevelt, president for the past five years. John A. Robinson, vice-president, Commerce Mining & Royalty Company, Miami, Okla.; J. O. Elton, manager, International Smelting Company, Salt Lake City, Utah; and C. Merrill Chapin, Jr., vice-president, St. Joseph Lead Company, New York, N. Y., were elected vice-presidents of the Institute. James A. Caselton, vice-president, St. Louis Smelting & Refining Company, was elected treasurer to succeed Mr. Young.

A short time prior to the meeting, the announcement was made that E. V. Gent, manager of the Carbon Black Export, Inc., and formerly secretary of the Zinc Export Association, had been appointed secretary of the Institute. Mr. Gent succeeds Julian D. Conover, who resigned in January to become secretary of the American Mining Congress, Washington, D. C.

The need for cooperation, not only from a profit standpoint but also from a political point of view, was poignantly pointed out in papers read at the St. Louis meeting by C. S. J. Trench and Dr. C. K. Leith, of the University of Wisconsin, vice-chairman of the National Resources Board, of which Secretary of the Interior Ickes is chairman.

Mr. Trench satirized the situation of the industry in its folly of uncontrolled production. He said that it seemed to be the idea of the industry to divide the deficits instead of the profits.

Dr. Leith said that his committee had definitely gone on record as against government ownership of natural resources and had recommended specifically to the President that special privileges be granted to the natural-resource industries which would allow them to so regulate their businesses that they could make a profit, and to conserve the natural resources of the country so that they would be available in times of stress. Since the World War, he said, the countries of Europe were becoming more and more interested in their mineral resources, with the result that nationalism was becoming an important factor. This wave of nationalism of natural resources was washing more and more upon our own shores.

Dr. Leith pointed out that one of the developments that was causing surpluses of some of the minerals was this nationalism of minerals. Many of the European countries, he said, in their efforts to make themselves self-sustaining, were diligently promoting the production of minerals, with the result that the supply of such minerals as zinc and lead had been increased tremendously and far in advance of consumption.

HOWARD I. YOUNG
President

E. V. GENT
Secretary

These papers on the problems facing the industry prompted the introduction of a motion by Mr. Young to the effect that a committee be appointed which would work out a peaceful plan of cooperation in respect to production, which plan was to be presented to the code authority.

Julian D. Conover, secretary of the American Mining Congress, gave a graphic description of affairs in Washington which were affecting the mining industry. He stated that it was his opinion that the NRA, in some form or another, would be continued.

The better-galvanizing program, started to promote a greater increase in the consumption of zinc, was given one day of the two days' program. The retiring president, Ralph M. Roosevelt, in his valedictory address before the convention, reviewed the progress made with the program in the past five years and advocated a larger expenditure of money in the years to come for fostering the use of "Seal of Quality" sheets. An extensive advertising program was advocated by K. J. T. Ekblaw, advertising manager of the Institute. A solid foundation had been laid in the campaign to date, he said, but a much larger appropriation for advertising was needed to build a permanent structure on the foundation.

A review of the economics of the zinc industry was given by R. B. Caples, of Great Falls, Mont., for the West, and by M. D. Harbaugh, secretary of the Tri-State Zinc & Lead Ore Producers' Association, and R. B. Paul, of the New Jersey Zinc Company. No future increase in zinc production was thought possible by an appreciation in the price of gold or silver, Mr. Caples stated. Zinc, he said, was a byproduct of Western mines, and its production would be more affected by an increase in the lead price rather than any further increase in the silver price. Further increase in the price of silver, he said, however, would have the effect of making curtailment of zinc production more difficult.

The convention was opened by an address of welcome by H. A. (Chief) Buehler; Charles T. Orr responded. The annual report of the treasurer, made by Mr. Young, showed that the Institute had a healthy balance of cash on hand.

• Property of Bralorne Mines, at Bralorne, in the Bridge River district of British Columbia, Canada. New orebodies have recently been opened up in the mine, principally on the eighth level. An extension of "C" vein, previously exposed in upper workings, has also been encountered on the same level

Exploitation Advances Along Canada's Ontario-Quebec Gold Belt

One-third of Area Extending From Matachewan to Louvicourt Lies in Ontario and Two-thirds Are in Quebec—Gold Output of Ontario Side Now Substantially Ahead of Quebec's—Important Gains Expected Soon in Quebec Areas

OF THE 150-mile gold belt that stretches continuously from Matachewan through Kirkland Lake, Rouyn, and Cadillac to Pascalis and Louvicourt, Ontario possesses one-third and Quebec has two-thirds. Output of the big mines at Kirkland Lake gives the Ontario section, at present, a substantial lead in gold production over the Quebec side; but Noranda's gold just about offsets that of Lake Shore, and if a few more mines like Beattie and Siscoe are developed, Quebec's gold output from this belt will rival that of the Ontario side. Last year the Ontario section produced $20,000,000 and Quebec $13,600,000; and if Noranda's copper is added to the gold, Quebec is already in the lead.

Last year the Kirkland Lake camp had an output of $20,600,000 from the three large and four medium-sized mines of the camp proper, and the smaller mines there and at Matachewan (the westernmost and somewhat disjoined part of the same belt) provided another $300,000. During the present year two more small producers have been added at Matachewan, and there may be one or two more at Kirkland Lake; but the total output will remain substantially the same.

Exploitation on the Quebec side is not nearly so far advanced as in Ontario. Noranda's 1934 gold output of $8,700,000 will probably be maintained at about the same level. Beattie's 1,100-ton mill will be doubled as soon as a satisfactory process has been found for treating its concentrate at the mine in place of shipping to a distant smelter. This will bring in $3,000,000 a year; and it is quite possible that the mine can support three times its present output, or even four. Near by, in Boischatel Township, Arntfield is building a 125-ton mill that will yield $500,000 a year, and its neighbors Francoeur and Lake Fortune are prospective producers on a similar scale. In Rouyn Township the McWatters 60-ton mill is treating ore running from 1 oz. to 1½ oz., and the mine is showing an unexpected volume of such ore, with a renewed promise of its extension below the first level, where the former work failed to find it. At intervals to the east are the O'Brien and Canadian Malartic mines, which promise to yield steadily at the rate of, say, $500,000 a year each.

Siscoe, the pioneer of the eastern end of this 150-mile belt, is likely on present evidence to increase materially its recent rate of $2,000,000 a year. The Sullivan is beginning to find deposits of similar character, though of undetermined extent, and as yet is only a small mine. Its neighbor, Greene-Stabell, is still confined to a small deposit. Lamaque, subsidiary of Teck-Hughes, seems about to reap the success that has, up to the present, been denied the Bussieres mine, sponsored originally by Treadwell-Yukon, both having tabular deposits of somewhat erratic nature. Perron Gold has a steady, small production and a mine that is expanding rapidly, and Tiblemont Island now looks like a mine of moderate size. This whole eastern section, characterized by rather erratic deposits in granodiorite, has advanced markedly during the past year and soon may have a very substantial production.

East of this, the gold-bearing granodiorite merges into a vast expanse of granite; but to the northeast there is a somewhat tenuous geological connecting link with another gold area that may be considered its continuation and now is distinctly interesting. Chibougamau is 160 miles northeast of the easternmost part of the Kirkland Lake-Rouyn-Siscoe belt. There Consolidated Mining & Smelting has installed two mining plants to test exhaustively extensive gold-copper showings. McIntyre and Noranda are investigating gold veins near by. Forty miles to the west at Opemiska, Ventures, Ltd., has copper-gold deposits of workable size and grade, and halfway out to the railway at Rose Lake there are newly discovered gold deposits. It is possible, therefore, that these and other prospects will develop sufficient ore to warrant the 150 miles of railway required to reach Chibougamau's copper-gold, and thus to double the length of the present 150-mile producing gold belt.

BRITISH COLUMBIA

• During March the Island Mountain mill, in the Cariboo district, treated 2,282 tons of ore, producing 1,440 oz. of gold, valued at $50,500, which compares with $37,060 in February. Slightly increased milling capacity is expected with the installation of another filter. March output of Cariboo Gold Quartz is reported at 1,354 oz. of gold.

The fourth annual report of Bralorne Mines shows a gross revenue of $1,580,324 and a net profit of $800,613 for 1934. During the year, 98,664 tons of ore were milled, recovery being 45,296 oz. of gold, with 6.28c. per ton in silver. Gold recovery was 94.99 per cent, and the average mill tailing assay was 0.0250 oz. gold. At the end of the year the milling rate had been stepped up from 200 to 340 tons; it is currently at 400 tons, with capacity at 450 tons per day. Reserves of developed and probable ore are placed at 300,000 tons, with grade uncertain. Ira B. Joralemon, consulting engineer, states, however, that the grade is certainly as much as

0.35 oz. per ton, and the scattered rich areas will probably make the mill heads average considerably more than this. Many improvements to camp and equipment were made during the year. The report states that ore developments were as gratifying as during the preceding year, the physical condition of the mine and mill are good, and that from now on, with efficient equipment and decreased costs, earnings should be most satisfactory. Dividends declared during the year totaled $775,000. During the year 26 of the company's claims embracing the eastern section of the property were sold to Bradian Mines, stock control being retained by Bralorne Mines. The subsidiary company was financed, active development commenced, and promising results are being obtained.

The main orebody on the Congress property, Bridge River district, is reported to have been struck on the No. 1 level, at 776 ft. The tentative option on the property held by Premier Gold Mining has been relinquished, and the Spencer-Sloan interests are said to be negotiating for control of the company.

An important mining project under way is that of the Hedley Mascot Gold Mines. The nucleus of the property is the Mascot fraction lying in the old Nickel Plate mine and known for many years to contain valuable orebodies. Many adjoining claims are consolidated in the company's holdings, the old Nickel Plate mine being operated by Kelowna Exploration. After a year of development and diamond drilling under competent engineering and geological advice it is stated that a total ore reserve of about $3,400,000 has been proved in the Hedley Mascot holdings, contained in approximately 200,000 tons. Plans are now being drawn up for a 2,800-ft. tunnel, a 5,000-ft. tramway, and a 150-ton mill. Cost estimates total $250,000. The company has been mainly financed in Vancouver, B. C.

Shareholders of Gold Belt Mines, Ltd., have ratified the agreement made by the directors with North American Mines, to develop the Gold Belt mine. Capitalization will be increased from one million to two million shares.

Reno Gold Mines has decided to commence work on the Nugget and Motherlode mines as soon as weather conditions permit. These old producers, now included in the Reno holdings, are credited with a former output of $2,000,000. Under present gold prices these mines have important potentialities.

Of great interest to British Columbia is the announcement that Consolidated Mining & Smelting, of Trail, will proceed at once with new construction in connection with the fertilizer plant. In part this will consist of an additional hydrogen unit and also a new plant to produce elemental sulphur from zinc plant gases, largely sulphur dioxide. Increased production of sulphuric acid will also be obtained. About $2,500,000 will be expended on these new plants, and employment for many men will be assured. The fertilizer branch of Consolidated is making steady progress, with a large export market for ammonium sulphate and largely increased sales of phosphate to the Canadian prairies. Production of sulphur from waste gases is an interesting step and will add one more product to the many materials which the company produces. A market will probably be obtained from the coast pulp and paper mills. The annual report of Consolidated Mining & Smelting for 1934 shows net profits, after all charges, of $2,211,559, equivalent to $3.39 per share, which compares with $1.62 per share in 1933. In 1934 a total of 1,748,401 tons of ore was mined from the Sullivan mine, and fully developed ore reserves above the 3,900-ft. level were increased by 2,341,000 tons. The further downward continuation of the orebody was confirmed by diamond drilling and was indicated as maintaining average width and satisfactory grade.

Development operations at the property of the B. C. Nickel mine, near Hope, have afforded exceptionally encouraging results during the past few weeks, a considerable body of high-grade ore having been encountered in a crosscut from the main tunnel at a point 1,600 ft. from the portal. This deposit, which is reported to be 160 ft. wide, has a nickel content of about 3 per cent, which is considerably higher than the average of the ore heretofore proved. About 1,000,000 tons of 1.25 per cent ore have been developed, and the company plans to erect a concentrating plant as soon as reserves of 2,000,000 tons of ore of this grade are assured.

Higher Wages and Increased Activity In Mexican Mining Areas

INCREASED activities and wage raises for miners featured the start of spring in the Mexican mining industry. Miners employed by contractors in the service of Minera Real del Monte y Anexas, operating at Pachuca, Hidalgo, received wage increases of from 40 to 80 per cent under new collective labor contracts. . . . Metalurgica de Peñoles has raised the pay of all workers of its Torreon, Coahuila, smelter who earned less than 3 pesos (about 90c.) a day, an action which it is said increases the smelter's payroll by 60,000 pesos (about $18,000, U. S.) a year. . . . A minimum daily wage of 2.50 pesos (about 79c.) has been established for surface and underground workers of mines in the Nocarzi zone, Sonora.

Roads are being built and other preparations are being made to put the San Francisco, Santiago and Tlalchichilpa mining properties, Cuautla municipality, Morelos, into condition for early working. . . . Five gold-silver veins are being worked at Mamalin; a rich gold deposit has been found at El Limon; work has started on the Picachos tract, and development is far advanced on the Acaponeta, Santiago Ixcuintla, Rosa Morada, Compostela, Santa Maria, and Ixtlan del Rio properties, all in Nayarit.

Machinery for a large treatment plant is being installed on the San Francisco mineral tract, Veta Grande municipality, Zacatecas, by Carnegie El Bote Mining. This company has purchased a large amount of equipment in the United States for a plant it is to erect at the El Bote mine, near Zacatecas City, and has increased the working personnel of that mine from 150 to 550.

Neg. Minera de Guadalupe de los Reyes has encountered an important gold-silver deposit in its mine near Guadalupe de los Reyes, Sinaloa. This company is building a road from its mine to a smelter at Dolores, Sinaloa, and has acquired a large amount of machinery and tools. It is also using electric power, and plans improvements at the Dolores smelter, including installation of a cynuaration system.

Silver exports of 1,838,811 kg., of which 1,611,457 kg. went to the United States and 189,797 kg. to Great Britain, are announced for last year by the Ministry of National Economy. . . . One hundred and fifty-four concessions to exploit mineral lands were granted to foreigners, most of them Americans, from Dec. 16 to March 15, according to the Ministry of Foreign Relations. . . . Foreigners are excluded from rights to work, or hold, special concessions in the federal mineral reserves, under a decree issued by President Lazaro Cardenas, which limits this privilege to Mexicans.

Mazapil Copper obtained an injunction from a Mexico City district court against the ruling of the federal board of conciliation and arbitration that the strike of its employees is legal. The strikers propose to carry the case to the federal supreme court. . . . Owners of the La Mariposa mine, Sinaloa, plan to invest 70,000 pesos (about $19,000, U. S.) in development work. . . . Higher prices of silver and other metals and greater demand for them

have resulted in many mines in Sinaloa that were abandoned for years resuming work. Development work is being pushed on the Buena Vista and La Paloma properties, in that State. . . . Mines in the Velardena and Pedricena districts, Durango, have a weekly payroll of 20,000 pesos (about $5,600 U. S.), and more miners are working in the San Bernardo, Guanacevi, Tepehuanes, Cineguilla, and Indé zones, in that State.

Striking employees of Amaparo and Piedra Bola Mining, Jalisco, and Mazapil Copper, Zacatecas, have asked President Lazaro Cardenas to mediate the conflict, saying that their demands for increased wages are reasonable, as many mining firms in Mexico have raised their workers' pay. . . . Minera, Fundidora y Afinadora de Monterrey has raised wages in its El Toro, Santa Barbara municipality, Chihuahua unit. . . . Beneficiadora de San Jose de las Bocas, operating in Rosario municipality, Sinaloa, is building a road to expedite shipments of its ores. . . . After a long suspension, work has resumed in the Minerva and Palmira mines and at the San Gil electric mining power plant, Aguascalientes.

The Ministry of National Economy reports the following status of the Mexican mining industry on Dec. 31, 1934: Companies operating, 220; number of treatment plants functioning, 90; number of mineral tracts being exploited, 14,088, covering 886,845 hectareas (a hectarea is 2.47104 acres); and 3,271 exploitation and 5,206 exploration concessions in effect.

Numerous prospectors, including several foreigners, are doing well working a rich gold placer deposit recently discovered near El Limon, Nayarit. Some prospectors are officially reported to be obtaining as much as one kilogram of gold each a week. . . . Prospectors have found several good mineral deposits in Chihuahua, Durango, Nayarit, Zacatecas, and Sinaloa, and are either working them on their own account or have sold them to mining companies, says the Ministry of National Economy. . . . Rich gold-silver deposits have been discovered in the Treinta y Cinco mine, San Javier municipality, Sonora, and the owners are erecting a large mill to treat the ores.

San Luis Mining is building model homes for employees of its Tayoltita unit, Durango. . . . Progressive increases in silver production taxes, step by step with rises in the metal's worth, of up to 35 per cent, when the price reaches $1.30, U. S., an ounce, have been ordered by President Lazaro Cardenas for the explained purpose of enabling Mexico to share in silver prosperity. He estimates that if silver holds a one dollar the ounce rate for a year, that will mean a revenue of 72,000,000 pesos (about $20,000,000) for the Mexican Government from silver taxes alone.

Underlying Stability of Gold Mining Boom Indicated by Security Markets

London Correspondence

THOUGH speculation and investment are commonly of little concern to the technician, they sometimes constitute the indicators of a trend which may be of most vital interest to him. Such has been true recently. A great many people in those European countries the currencies of which are still on a gold basis had been hoarding gold, and now, fearing their governments may require them to surrender it, they are buying dividend-paying gold-mining shares in the London market. As a result of such buying, some new high record prices have been established, and brokers have reported that the supply of high-grade gold-mining shares is scarce. All this is taken to mean that there is stability underneath the gold-mining boom, that the search for, development, and equipment of gold deposits will continue, making employment for engineers and metallurgists and business for machinery manufacturers. Economists are beginning to say that from such activities in gold mining great eras of industrial and national prosperity have in the past sprung.

Private advices from Africa state that rich disclosures are being made by Loangwa Concessions in the gold area it is exploring in Northern Rhodesia. The officials are not ready, apparently, to make any further statement. As is well known, the work is under the direction of men who will neither be misled nor will mislead others by shouting over rich disclosures—men who know it takes more than high-grade samples to make mines.

Recent borehole results in the Dunrobin property of Luiri Gold Areas have been much less sensational than those first reported. No. 6 drill cut 57 in. of 8.3 dwt., and deeper down found the new orebody at a point where it contained only insignificant and noncommercial values.

Cam & Motor Gold Mining has arranged to develop adjoining Eileen Alannah Mining's property from its deep workings. This arrangement, which is an elaborate one, involving options on large blocks of Eileen Alannah shares, is the result, of course, of the excellent values which Cam & Motor has found at great depth in its own mine. The results will be watched with keen interest by many others engaged in mining in Southern Rhodesia, as the possibilities of deeper developments are being given more study now than ever previously.

Some expectation exists that Southern Rhodesia's gold premium tax may be reduced, or even abolished. President Bayliss of the Rhodesian Chamber of Mines is strongly opposed to the tax on the ground that it is retarding the development of low-grade ores. The government is eager to speed up gold-mining activities, and plans to encourage it by an aërial survey of specially selected areas.

The 1934 mineral output of Southern Rhodesia had a value of £5,687,615, an increase of £747,980 over that of the previous year. Value of gold was £4,695,746, an increase of 17 per cent, due chiefly to the operation of more small mines. An interesting development is that £10,000 worth of tungsten was produced last year in the Wankie district. This metal is now being systematically sought elsewhere throughout Southern Rhodesia.

Negotiations are said to be under way for the reorganization and financing of the manganese-mining industry in South Africa. The Potmasburg district is thought by some to contain the largest deposits of manganese ore in the world. A company was formed in 1929 to exploit the ores, but the scheme was defeated by the reduced demand and low prices brought by the depression. A strong financial group is understood to have now taken up seriously the matter of production on a large scale.

The astonishing effect that the premium on gold is having on the profits of some high-grade producers makes the Arabian Nights Tales seem dull and insipid. For instance, in March, Ashanti Goldfields produced 15,044 oz. of gold, worth, at standard value, £63,906. Its total expenses, including £10,679 for government royalty, mines development and depreciation, were—computed in standard—£30,198. But that is not that. Its net profit, including the trifle of £3,200 of other earnings, was £73,293, or £9,387 more than the total standard value of the month's production. This means that the premium paid all its expenses and charges and gave it, in addition, £6,187 net to add to the standard value of its product.

(Continued from page 244)

of 100 tons per mill per week production. Two new plants are being constructed, one plant that has been idle for several years is being rebuilt, and several plants now idle may resume production soon, especially if ore prices move upward, which they seem likely to do. That tailing mill output will amount to 2,500 tons a week during the summer months is a possibility. At present the output has climbed to 2,100 tons, which equals the high level of all time reached last year.

Construction of a plant that will have a capacity of from 60 to 70 tons an hour has been started on the Mary Whitebird allotment at Picher, Okla., by Tri-State Zinc, Inc., a subsidiary of Consolidated Gold Fields of South Africa. The plant will be similar in design to the Ottawa mill of the company, at Picher, and the Chitwood mill of the Missouri Mining Company, a subsidiary of the Tri-State, near Chitwood, Mo., according to H. M. Loveman, manager of the Tri-State and Missouri companies. The mill will have three six-cell rougher jigs with center feed and one six-cell chat jig, which also will have a center feed. Chats will be ground to $\frac{1}{8}$ in. before being treated on the chat jig. The sludge feed, which will be ground to $1\frac{1}{2}$mm., will be treated over eleven tables. The flotation section will have a capacity of from 10 to 15 tons an hour. Tailing will be loaded by power shovel and hauled to the plant in trucks and trailers. The plant is expected to be ready for operations early in July.

Tri-State zinc has made arrangements to rerun the Crawfish and Goodwin tailings, belonging to Crystal Mining, over the Ottawa mill. Charles A. Neal, of Miami, is president of the Crystal company. This contract will enable the Ottawa mill to be operated at least another two years. Tri-State has not yet completed rerunning all of the tailing from the Big Chief lease, which it owns.

Semple Mining, which is operating the Semple tailing mill on the Brewster land, east of Picher, is rebuilding the Early Bird mill, near Treece, Kan., and expects to reopen this mill soon, according to C. Y. Semple. Tailing from the Muncie, Big Elk, Southern, and Muncie mines will be treated over the Early Bird mill. These tailings will be loaded on cars by power shovel and trammed to the mill.

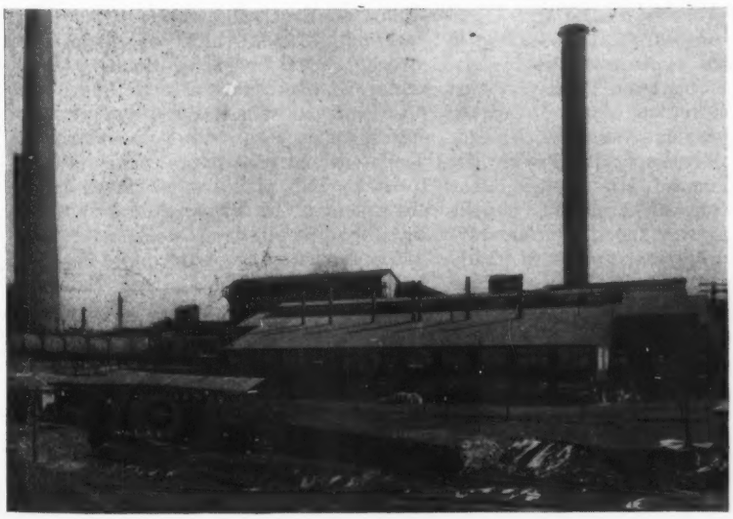
No. 3 mill of Beck Mining, on West 19th St., Baxter Springs, Kan., has recently been converted into a tailing mill and is being used to treat the Ebenstein tailing, northwest of Baxter Springs. The Ebenstein mine was worked by the old Chanute Spelter Company, a subsidiary of American Metals. Charles Beck, of Miami, is president of Beck Mining.

Youngman Milling, which has been treating the tailing from the old Bob White mine of Commerce Mining & Royalty, has obtained the old Tom L tailing from the Commerce company and expects to start treatment of this tailing within the next month.

Atlas Milling, which has just completed the treatment of the old St. Louis Smelting & Refining tailing at St. Louis, Okla., has obtained the tailing at the Mary M mine, east of Picher, Okla., and is treating this material.

H. G. Weidman and associates, of Baxter Springs, have obtained a lease on the old Kropp mine of St. Louis Smelting & Refining and are operating the plant under the name of St. Nicholas Mining.

• Lead refinery of United States Smelting, Refining & Mining, at Midvale, Utah, which was recently closed down. The plant, according to the company, may be reopened this summer, depending on the condition of the lead market. During the suspension of operations experiments will be made on methods to improve metallurgical processes. Operation of the adjoining mill and smelter have not been affected. Bullion is being shipped to the company's East Chicago plant



MICHIGAN

• At the Ropes gold mine, near Ishpeming, which is being reopened by Calumet & Hecla Consolidated Copper, rails and guides have been installed in the shaft so that a skip to handle men and supplies can be placed in use. The shaft is not yet entirely dewatered, but no water is entering the workings already uncovered. A hoist has been installed and a compressor soon will be ready to start operation. To the west of the Ropes property, where a number of "forties" are under option by the company, exploration is in progress.

Calumet & Hecla plans a thorough geological and exploratory examination and study of the lands it holds under long-term leases and option. For many years gold-bearing deposits have been known to exist in the Ishpeming district, about 100 miles from Calumet, but the exploration of these lands in the past has been sporadic and indeterminate. The nature, size, and possible commerical value of the deposits will now be determined by Calumet & Hecla by means of its program of intensive examination of these properties. The work can be done economically because of accessibility, with respect to labor, equipment, and local administration, to the main operations at Calumet.

Other exploratory projects have been or will be undertaken. One of these will be the opening of a mineralized fissure vein discovered in diamond-drilling operations on lands of the company east of the old Central mine, in Keweenaw County, in the Michigan copper district. A shaft, already started, will be sunk to the necessary depth, a crosscut driven to the fissure, and openings extended in it both north and south to determine its mineral values. Geologists are also making a preliminary geological survey and study of certain western properties considered favorable for exploration. Options covering these are held available for acceptance by the company if the geological examinations warrant such action.

At the Copper Range property, a good copper showing has been uncovered in the vein opened over a Conglomerate bed and now believed to be the Baltic lode, in which the Champion mine is operating. The lode was disclosed in a crosscut from the eighteenth level of Champion No. 4 shaft, and the copper showing is near the north boundary of the company's lands formerly owned by the St. Mary's Mineral Land Company. The vein was opened south of the crosscut for a distance of 876 ft., of which 583 ft., or better than 66 per cent, was good

or fair. A total of 201 ft. of crosscutting also was done to determine the width of the lode. The vein is still to be opened in the area north of the crosscut.

The electrical crushing installation in the Champion mill of Copper Range, which has been idle for some time owing to the necessity of making further changes in the design of the crushers, was expected to be put in operation again late in April. To protect against wear of some of the parts, a decision was made to line the crushers with alloy steel to replace the chilled iron formerly used. A strike at the steel foundry delayed shipment several months, and imperfect castings required further replacement. The belief prevails that the change will permit regular operation of this plant. During the trial run, upon the installation of the crushers, a reduction in operating costs of 27 per cent was indicated.

• Gold bullion is poured twice a month at the property of Benguet Consolidated Mining, along Antamok Creek, in the Philippine Islands. The gold bricks, on cooling, are weighed, then wrapped and taken to the Baguio postoffice for shipment to the United States, where they are refined. Value of each pouring totals about $150,000 in gold and silver

IDAHO

• Sunshine Mining, operating the nation's premier silver mine, has definitely withdrawn from having any dealings with employees under the terms of Section 7-a of the National Industrial Recovery Act and has posted notices to that effect at the mine property on Big Creek. In explaining the company's position, Frank Eichelberger, vice-president and manager, issued the following statement, which was placed on the bulletin board:

"This company is advised by counsel that inasmuch as its business is not interstate it is not subject to federal control under the National Recovery Act, with respect to the relations between employer and employee.

"You are therefore notified that from this date forward this company will not deal with its employees by virtue of Section 7-a of the Industrial Recovery Act.

"Any employee or groups of employees is welcome to bring or cause to be brought to the attention of the company any matters relating to the mutual interest of the employees and the company.

"It is the hope of the management that mutual problems may be freely discussed and that a spirit of cooperation may characterize both the discussions and actions of employer and employee."

Mr. Eichelberger addressed the employees when they came off shift and stated that wages, working hours, and days worked per week would not be changed by the new order. He asked the employees to address any complaints or suggestions to the shift bosess, foremen, superintendent, or to himself. He stated that the company would not deal with the local union, No. 18 of the U. U. M. M. & S. W., of Kellogg only, but that all representatives would be met on equal ground.

Early reopening of the old Empire mine, one of Custer County's largest mining properties, is practically assured by negotiations of the Board of County Commissioners with J. Ray Weber, of Mackey, and M. G. Thomle, of Los Angeles, with reference to settlement of tax matters. Operations are expected to begin within 60 days. The property has been idle since 1930 on account of the low metal markets, but for 30 years prior to that its operations furnished steady employment for a large force of men.

Operations at the Silver Dollar property are on schedule, according to C. O. Dunlop, Spokane, an official of the company. "The crosscut is going ahead at the rate of about 7 ft. per day," Mr. Dunlop stated. "The miners are making good progress, and at that rate it will not be long until the crosscut approaches its objective, the eastward extension of the Sunshine vein in the Purim group."

The shaft at the Metropolitan Mines Corporation property on Big Creek was down 104 ft. on March 31, according to R. S. Merriam, engineer in charge.

Restoration of good transportation facilities with return of good weather will find a sizable shipment of lead-silver-zinc-gold concentrate leaving the new Giant Sunrise Mining mill, near Troy, according to Arnold Litchfield, general manager. Three or four carloads of concentrate are now ready for shipment. The mill is working smoothly but needs a few minor adjustments.

James F. McCarthy, president of the Hecla Mining Company, recently announced that the Hecla orebody had been opened on the 3,200-ft. level, which meant the addition of 400 ft. of additional ore reserves. The disclosure of this ore at this great depth means years of added life to Hecla, which has long been one of the consistent producers of the Coeur d'Alene district.

Diamond-drill operations at the Mineral Point mine of Coeur d'Alene Mines are proceeding with satisfactory results, according to reports from the property. The work is under way in the upper levels of the mine and will later be carried on in the deeper levels.

The Morning and Page mines of Federal Mining & Smelting, in accordance with instructions posted by General Manager Washburn, are on a straight five-day week program and will continue on that basis. Surplus metal will be carried in storage, the company borrowing money for this purpose to the extent of $1,500,000 from American Smelting & Refining over a three-year period, the management feeling that the depression will be over by that time and the movement of stocks to the trade reach such proportions that a repayment of such a loan could be made. This method will withhold from the present market any oversupply of stocks and at the same time permit of enlarged operations at the mines. The A. S. & R. will draw 4 per cent interest on its loan, with lead and zinc as collateral at not more than 3c. per pound. This plan was recommended by President F. H. Brownell and approved by the directors and stockholders. Its adoption was one of the most cheering items to come to the Coeur d'Alene district in a long time and has already had its reflection in improved business conditions and increased incomes for the employees of the company, numbering more than 650 in the district.

Milling operations at the Golconda property were closed down on April 1, William A. Beaudry, manager, reports. Underground development work will be

carried along without interruption and additional ore reserves made available for mill treatment when metal markets justify such operations.

Liberal King Mining, operating in the Pine Creek district, reports an important ore disclosure made when the 3,400-ft. crosscut tunnel intercepted the vein at a depth of 1,000 ft. below the tunnel. The ore is along the footwall side and shows across an 8-ft. face. The ore is of fair milling grade, containing lead, silver, and zinc.

The Polaris shaft was the scene of an ore disclosure on April 12, when a vein was uncovered on the 730-ft. level. Assays of the ore showed 55 oz. of silver to the ton. The discovery was unexpected, as the main parent Polaris vein is about 300 ft. south of the vertical shaft and dipping away with depth. Exploration work will be carried out on the vein at a later date, the management carrying on steady sinking operations to reach the 1,000-ft. level as early as possible. A 4,800-ft. tunnel is also under way to meet the bottom of the shaft for a working adit. Hecla and Newmont control the Polaris company. The property adjoins the Sunshine on the east.

Mines in the Silver City district, Owyhee County, are preparing for a busy season when the snow disappears, according to engineers who have lately visited the district. Eastern capital will take over some of the well-known properties.

By reason of a satisfactory arrangement with its creditors, Hypotheek Mining & Milling plans to soon become active again in the development of its property near Kingston and will also enlarge its operations at its newly acquired gold property in the Murray district. Announcements to this effect have been made to the stockholders by Otto A. Olsson, secretary-treasurer and manager of the company's property.

The 3 per cent tax on the net incomes from mines, passed by the recent session of the Legislature, was signed by Governor C. Ben Ross as the last measure to receive his endorsement before the time had expired for his action on April 1. The measure goes into effect within 60 days. The Governor had expressed some doubt as to the wisdom of the mines tax bill, which, he is understood to have stated, would undoubtedly drive capital from the State and work a hardship on the operating companies, now barely able to maintain their payrolls. The bill had been condemned by business men of the State.

An ancient lake bed of a tributary of Trail Creek, near Delta, in the Murray gold belt, will be the scene of placer operations this summer, when W. H. Buell, of Spokane, will drain the lake and seek the gold he believes to be in the gravels at the bottom of the lake bed. The scene of operations is in Lake Gulch, where placer operations were conducted about 40 years ago when the gold rush was at its height. The gulch is several miles in length and is reported to have yielded a considerable amount of the yellow metal, evidence of the primitive methods used by the miners of that day still being observable.

The deep tunnel operations at the property of Mineral Mountain Mining & Milling are progressing steadily under the direction of Fred Thiel, manager. The company plans to install complete equipment as soon as the snow leaves and heavy hauling is possible.

UTAH

• Mining in Utah will be appreciably stimulated by the increase in the price of silver. Already, operators of properties in remote districts are awaiting a reopening of roads in order that they may resume operations. A number of other mines have started operations and shipments again.

United States Smelting, Refining & Mining has announced that it will reopen its Eagle and Blue Bell property at Eureka. Practically all of the underground work will be handled under the leasing system. Lighter equipment will be installed to reduce operating costs, with single-deck cages replacing the double- and triple-deck cages formerly used. Operations have been resumed at the Zuma and Tintic Gold mines, also in the Tintic district.

Operations at American Smelting & Refining's Murray lead smelter were suspended on April 1. William J. O'Connor, manager, announced that the company would continue to buy ore, which will be stockpiled until sufficient is accumulated to warrant a resumption of operations.

The new gold-silver orebody opened up above the 2,100 level of the Mammoth mine, in the Tintic district, continues to show improvement, according to Samuel McIntyre, president of the company.

From its Eureka Lilly property, Chief Consolidated Mining is shipping two to three carloads of ore ranging from 0.75 to one ounce gold to the ton. This ore is on the 900 level. At the same time the company is sinking a shaft from the 1,300 level to prospect another showing of ore.

The rise in the price of silver has stimulated activity at the Horn Silver mine of the Tintic Lead Company, in Beaver County. Operations in the King David mine have been resumed on the 750 level for the purpose of cutting the extension of the Horn Silver shear zone. Returns from a carload of ore shipped recently from the Horn Silver mine carried 57.6 oz. of silver to the ton, $1.70 in gold, and 14.6 per cent lead. This ore was mined from a deposit being followed down from the surface.

At Bingham, American Smelting & Refining is drifting from the 1,560-ft. level of its new shaft, sunk to develop the company's lease on Utah Metal & Tunnel and Utah Copper ground.

Ore is being shipped from Ophir Midland Mining's property in Ophir Canyon. Ore is also being produced from the Fiske tunnel and from the Gem tunnel, 760 ft. above the Fiske.

An agreement has been signed by Park City Consolidated Mines, whereby the company will be entitled to connect its 900-ft. level with a north drift from the Ontario drain tunnel of Park Utah Consolidated Mines. About 900 ft. of drifting will be necessary to reach this outlet. Park City Consolidated plans to install pumps capable of handling 1,000 gal. per minute, so that operations below the 900 level can be increased in scope.

The third of three fissures is being prospected 1,800 ft. from the portal of the Mayflower tunnel of New Park Mining, in the East Park City district.

Leasers in the Columbus-Rexall mine, at Alta, are preparing to ship six carloads of silver-gold ore as soon as the road is reopened for hauling.

Plans are being made by George H. Watson, manager of Alta Champion Mining, for development of the bismuth oreshoot opened up last summer in the Dwyer drain tunnel at Alta. This orebody was exploited in 1924 in workings 800 ft. above. Assays indicate that the company has a considerable body of bismuth glance averaging 3 per cent bismuth, 14.5 oz. of silver, 1.7 per cent copper, and 0.065 oz. gold per ton.

The opening session of the prospecting school being sponsored by the Utah State Department of Public Instruction was attended by 250 people. Sessions were held at the University of Utah Mines building. The object of the school is to increase the ability of prospectors and to develop the resources of the State. Harry S. Joseph, president of the Great American Prospectors' Association, and Frank J. Gunnell, geologist for the State Tax Commission, spoke at the opening session. George H. Watson, Salt Lake City operator, was elected secretary.

NEVADA

• Enlargement to 150 tons' capacity of the 50-ton cyanide mill of Hartford Gold Mining, operating the Hartford mine above Silver City, is forecast. Inadequate settling capacity has been remedied, and a substantial reserve of good mill ore is said to be available in two wide veins opened by a tunnel and shafts. George Drysdale, veteran Comstock mine manager, is in charge.

Operators in the Pioche district, Lincoln County, notably the Snyder group, of Salt Lake City, are taking active steps to secure the extension to Pioche and tributary districts of power-transmission lines from Boulder Dam. The project involves extension of the line to Ely and Kimberley for use of Nevada Consolidated Copper and Con-

solidated Coppermines. The plan provides for the power districts' issuing bonds in the sum of $1,500,000, secured by contracts for the purchase of power, to cover construction costs. E. H. Snyder said the Pioche companies probably would invest $2,500,000 in smelters and improvements at Pioche and $5,000,000 near the dam for refineries and fabricating plants, giving employment to 2,000 men. Individual power districts are in process of formation.

With the assistance of State engineers, a survey is about to be conducted to ascertain if sufficient pay ore is available in tributary districts to warrant construction of a combined cyanide and flotation mill at Fallon, seat of Churchill County, under the loan provisions of the Scrugham and Pope bills. A Washington report said that Dr. John W. Finch, director of the Bureau of Mines, had authorized an investigation of the project's feasibility and had so advised Representative James G. Scrugham, of Nevada.

Construction of a mill to treat silver-lead ore from mines on Prospect Mountain, 3 miles south of Eureka, is in prospect, according to J. A. Hogle, of Salt Lake City, head of Eureka-Prospect, which has reopened some of the old mines. Ore in this area contains more silver and is less base than the product of the Ruby Hill mines to the north, at one time the nation's foremost producers of lead.

A churn drill is being used to develop a water supply for the mill of Stone Cabin Consolidated, near Como, in Lyon County. With 500-ton mill capacity, production has been restricted to around 150 tons per day by shortage of water. Ore is caved from an open glory hole to a pocket at the adit level. This ore is mined from the wide outcrop of the Pony Meadows vein, which is to be mined in future by power shovel and trucked to the coarse-ore bin. Eight Fahrenwald flotation cells have been added to the mill equipment.

Two drifts from the new shaft are reported in excellent mill ore in the Dan Tucker mine, east of Fallon and operated under option by Rosetta Mines. Connection is to be made 340 ft. to the north with the old incline shaft which in earlier operations produced a substantial tonnage of high-grade mill ore.

Development by Mountain City Copper, an Anaconda subsidiary operating in northern Elko County, has blocked 200,000,000 lb. of copper above the 500-ft. level, according to the report of J. O. Elton, president. The four-compartment shaft was completed to the 500-ft. point, with stations at the 200, 400, and 500 levels, and connection was made with the old incline. On the 500 level, 1,571 ft. of work was done, the vein was exposed below the flat fault, and a winze is being sunk in ore to the 600 level. Preparation is being made to ship ore by June 1 to the International smelter at Tooele, Utah.

Reconstruction of a 100-ton cyanide mill lately destroyed by fire on property of Ohio Gold Mines, at Goldpoint, Esmeralda County, has been started under direction of Dr. Otto Dieckmann, president, who came by plane from his Cincinnati office following the fire. Two 200-hp. diesel engines, housed in a separate building, escaped damage, as did the ball mill, but the mill structure was razed.

Foundations for a 300-ton flotation mill at the Como Mines property, 8 miles south of Dayton, are nearly completed, and structural materials are being delivered. Stopes are being prepared in the wide Como vein, in which the ore is all sulphide below a depth of 125 ft., and ore for the flotation mill will be drawn from this vein. Later a cyanide plant will be added when ore is drawn from the equally wide Rapidan vein and the narrower Yerkes and other fissures. Published reports to the effect that Como Mines had made application for an RFC loan are without foundation, and officers say that present financing is adequate for all requirements.

Below Silver City, in the Comstock district, the 150-ton cyanide mill of Dayton Consolidated is reported operating at capacity on ore of high mill grade. Much of the product is coming from the 300-ft. level, lately unwatered. Deeper levels are said to have been under water for about 50 years.

Old mines at Tuscarora, once Nevada's leading producer of precious metals, are to be reopened by Goldbug Mining & Milling, lately organized for the purpose by a group of Tuscarora and Idaho men. Records indicate a district production of about $40,000,000, the greater part being silver.

The main tunnel of East Standard Mining at Midas, Elko County, has reached a point 900 ft. from the portal, according to Harry Joseph, manager. Within a short time, the company expects to cut the downward extension of the orebody opened on the surface.

At the Bristol mine of W. F. Snyder & Sons, at Pioche, the company is employing about 50 men. Production is running about 1,600 tons a month. Most of the work is being done between the 700 and the 1,200-ft. levels on the Gypsy oreshoot. A 1,000-ft. drive to cut the orebody from the bottom of the shaft on the 1,700 level is planned.

MINNESOTA

• In spite of difficult handling owing to cold weather, iron-ore shipments started with a rush the first of April from the underground mines to Duluth-Superior docks. The main reason for this hurry was the new emergency freight rate of 11.2c. per ton effective April 18. The steamer "Michigan" loaded at the Superior Great Northern dock on April 26, the first boat to load ore this season, with the steamer "Sheadle" coming second. Opening of the Soo canal took place on April 16, two weeks ahead of last year's opening. The general prediction for this season's shipping still holds at 30,000,000 tons. Though May 1 is the usual starting time for the Mesabi range washing plants for a normal production, some of them are a week ahead, as the Mesabi Chief plant at Keewatin started April 22 and the Harrison plant of Butler Brothers was a close second.

One of the first Mesabi range pioneers will receive deserved recognition when the Hibbing Old Settlers Association on Memorial day dedicates a monument of northern Minnesota marble to George R. Stuntz. Stuntz Township, in which Hibbing is situated, was named after this pioneer.

Better times were predicted for Hibbing when the Minnesota Legislature passed the North Forty Bill over Governor Olson's veto during the first week of April. This bill, approved with a referendum by the people of Hibbing, permits the purchase of the property in dispute by the several mining companies, Oliver Iron Mining being the most heavily interested, the mining companies to receive some relief from taxes. About $4,000,000 will be paid for the property under dispute.

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Bureau of Mines Advisory Board Holds First Meeting

In response to invitations from the Secretary of the Interior, 24 members of the Advisory Board to the Bureau of Mines met in Washington on Monday, April 15, with Director John W. Finch and the branch chiefs of the Bureau. After a brief statement by Dr. Finch, outlining the organization and functions of the Bureau, the Board elected Howard N. Eavenson as chairman and Julian D. Conover as secretary.

The day was spent in consideration and discussion of matters of general Bureau policy affecting relations with the mineral and allied industries and with the public.

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Calumet & Hecla Requests Revised Quotas

Calumet & Hecla Consolidated Copper Company has applied for exemption from the sales quota provision of the Copper Code, to the extent that monthly sales quotas for February and March, 1935, would be reckoned at 2,750 tons instead of the 1,100 tons assigned the company.

Suggestions or objections concerning the application must be submitted before May 14 to Deputy Administrator W. A. Janssen, 606 Albee Building, Washington.

The application refers specifically to Section 6 (2) of Article VII.

PERSONAL ITEMS

A Position Is Open on the editorial staff of *Engineering and Mining Journal* for a young graduate mining engineer with several years' experience and preferably with an interest in the economic aspects of the mining industry. Address The Editor, giving complete personal information.

C. S. Anderson, mining engineer, sailed from San Francisco for Australia on May 9.

Harold Gustafson is now engineer at the Volunteer mine of Pickands, Mather & Company at Palmer, Mich.

R. M. Atwater, Jr., of New York, is dividing his time between the Austin and Copper Canyon districts in Nevada.

John Boulding has been appointed mill superintendent at the Cariboo Gold Quartz mine, Wells, B. C.

Sydney H. Ball, of Rogers, Mayer & Ball, is spending May in the Northwest on professional business.

H. D. Keiser, associate editor of *Engineering and Mining Journal,* has been obliged to resign on the advice of his physician.

F. W. Jones, formerly assayer and surveyor for the Keystone Barefoot Mines, Inc., at Goodsprings, Nev., is now placer mining near Sparta, Ore.

Dr. T. W. Gevers has been appointed to the chair of geology at the University of the Witwatersrand, succeeding **Prof. R. B. Young.**

Augustus Locke, consulting geologist, has returned to his San Francisco office after an extended examination of mines in Goldfield, Nev.

Charles Dean Wilkinson has become consulting engineer for the several projects headed by Walter E. Trent, of New York, and associates.

Albert E. Faul, formerly manager of Ora Banda Amalgamated, N.L., has accepted the managership of the Lancefield mine, Laverton, Western Australia.

Dr. G. K. Williams has been appointed assistant general superintendent of Broken Hill Associated Smelters, Port Pirie, South Australia.

Theodore Baldwin is expected to return to Nevada soon from New York in connection with new work on extensive placer properties in Nevada.

Carl Davis, technical director of the Anglo-American Group of Companies, has been elected president of the Institution of Mining and Metallurgy.

Dr. W. S. Dyer, lately with the Ontario Department of Mines, is making field examinations for O'Brien Gold Mines, Ltd.

E. V. Butler, formerly flotation mill foreman of the Golden Chariot-War Eagle Mines, Inc., of Silver City, Idaho, has joined the staff of Park City Consolidated Mines, at Park City, Utah.

Alfred Chester Beatty has been awarded the gold medal of the Institution of Mining and Metallurgy in recognition of his distinguished services to the mining industry.

Capt. J. G. Ross, of Thetford Mines, in Quebec, Canada, was recently unanimously elected president of the Canadian Institute of Mining and Metallurgy.

W. A. Munds has been appointed superintendent of Boriana Mining, Yucca, Ariz., replacing **A. J. Kant. D. K. Harper** is now mine foreman and **Frank Brown** is in charge of the mill.

William M. Saben has been appointed manager of the United Verde branch of Phelps Dodge. He had been assistant manager at Copper Queen and at Morenci. Mr. Saben has been connected with Phelps Dodge for 25 years. He was educated at Dartmouth and the University of California and started practical mining work with the North Star, at Grass Valley, Calif.

WILLIAM M. SABEN

W. V. DeCamp, former manager for United Verde Copper and now in charge of the Bishop Creek mine for Cardinal Mines, in California, has been investigating developments near Tonopah.

W. M. Asselstine, for many years mill superintendent at the Premier mine, Stewart, B. C., has resigned to accept the appointment of manager of the Hedley Mascot, at Hedley, B. C.

Oliver E. Jager has joined the staff of the Ashanti-Adowsena (Banket) Goldfields, Ltd., the post-office address being Box 44, Odar, Western Akim, Gold Coast Colony, West Africa.

E. N. Pennebaker has received leave of absence for several months from Consolidated Coppermines, during which time he will make a special investigation for Phelps Dodge at Bisbee, Ariz.

Frank W. Griffin, consulting engineer, Bulolo Gold Dredging, has returned to his office in San Francisco from an inspection tour to Colombia and other South American countries.

Louis S. Cates, president of Phelps Dodge Corporation, after a brief stay in San Francisco, left for Arizona to inspect his company's properties at Bisbee, Ajo, Morenci, and Jerome.

Frank C. Mulford, metallurgist, of New York, has been at the Como Mines property, Nevada, where he will assume charge of a 300-ton flotation mill upon its completion.

Fred Buckle, formerly on the engineering staff of the Granby company at Anyox, B. C., has been appointed general superintendent of the Clubine-Comstock Mines in the Nelson district, B. C.

Stephen Atkinson, formerly superintendent at the Cariboo Gold Quartz mine, Wells, B. C., has resigned to become mine manager of the Meridian mine, at Camden.

Thomas D. Gillis, prospector and miner, plans the erection of a number of small, light, inexpensive plants of the "coffee-grinder" type for working surface showings in the region of Winnemucca, Nev.

Glenville A. Collins has returned to San Francisco after a four weeks' trip to Washington and New York, which he visited in the interests of the Grass Valley Imperial Mine, which adjoins the Empress at Grass Valley, Calif.

A. W. Fahrenwald, who has been acting dean of the University of Idaho College of Mines, has been appointed dean of the college, succeeding John W. Finch, Director of the United States Bureau of Mines.

J. J. Beeson, consulting geologist for Park City Consolidated Mines, has been elected president of the Silver Lead Syndicate, the offices of which company have been moved from Los Angeles to Salt Lake City, Utah.

Frank M. Smith has retired as smelter director of the Bunker Hill & Sullivan Mining & Concentrating Company. The position has been discontinued. Mr. Smith will continue to act in an advisory capacity with Bunker Hill interests.

H. C. Carlisle, of San Francisco, has been at the Dixie Valley mine, in Churchill County, Nev., owned by Comstock Keystone, to check on work of Pardners Mines Corporation, which has an option on the property.

J. F. Frost has been appointed mill superintendent of the 150-ton cyanide plant of Minera de Los Azules, Santa Barbara, Chihuahua, Mexico, which will be ready for operation about the middle of this year.

Roy K. Brown, for a number of years consulting engineer or manager for Nevada and California operators, now living in Oakland, has been examining gold properties in several Nevada districts.

D. M. Shaw, recently development foreman at San Francisco Mines of Mexico, San Francisco del Oro, Chihuahua, Mexico, is now mine foreman at Tecolotes mine, Santa Barbara unit of A. S. & R., Santa Barbara, also in Chihuahua.

Judge John W. Haussermann, president and general manager of the Benguet Consolidated Mining Company, recently arrived in San Francisco from Manila, P. I., and plans to visit New York and other Eastern points on professional business.

F. W. Varney, until recently general superintendent of Gold Circle Consolidated Mines, at Midas, Nev., has sailed from San Francisco for Manila, P. I., to join the staff of Engineering Equipment & Supply Company, with offices at 13th and Atlanta Sts., Manila.

John Howeson, one of the leaders in the recent ill-fated commodity pool operations in London, has resigned from the board of Consolidated Gold Fields of South Africa and as chairman and director of London Tin Corporation and Anglo-Oriental Mining Corporation.

E. A. Montgomery, president and manager of Comstock Keystone, has been at Mohave, Calif., where his long-time associate, **Clyde Garrett,** lately discovered rich gold ore on Middle Buttes, the ground having been acquired under long-term lease by Walter E. Trent.

W. Hobart Duff, of Crossle & Duff, Pty., Ltd., Melbourne, Australia, representatives of The Dorr Company, Inc., in Australia and New Zealand, is visiting the United States with his family and familiarizing himself with the latest practices in chemical, metallurgical, and industrial engineering.

Bela Low, mining engineer, and **Sherwin F. Kelly,** geologist and geophysicist, have moved their offices to 1 Cedar St., New York City, the new headquarters of Combined Geophysical Methods, Inc. Mr. Kelly recently lectured on geophysics before the Colorado section of the A.I.M.E.

Ray J. Barber, consulting engineer, San Francisco, recently left Los Angeles by airplane for Bogota, Colombia, S. A., to investigate gold placer deposits held under option by San Francisco and New York interests. **Joseph A. Mayolo,** mining engineer, accompanied Mr. Barber.

William F. Hayden, consulting mining engineer, has contributed to the golden anniversary edition of the *Grants Pass* (Oregon) *Courier,* published on April 3, a review of the mineral resources of southwestern Oregon. **Amos Earle Voorhies,** publisher of the *Courier,* has directed the destinies of that publication for 38 years.

J. T. Shimmin has completed the construction of a modern 500-ton complete flotation mill for the Sunshine Mining Company, at Kellogg, Idaho, which is now producing in excess of 425,000 oz. of silver per month. He returned to Telluride, Colo., on April 1, where he is manager of San Juan Metals.

Dr. C. K. Leith, economic geologist and chairman of President Roosevelt's Planning Committee for Mineral Policy, National Resources Board, will address the Coal Division of the American Mining Congress on May 17, at Music Hall, Cincinnati, Ohio. His subject will be, "The Purpose of the Planning Committee's Recommendations to the Mining Industry."

Edward G. Montgomery, superintendent of the Sullivan mine of the Consolidated M. & S. Company at Kimberley, B. C., has been promoted to take charge of the company's mining operations in eastern Canada, with headquarters in Montreal. He is succeeded at Kimberley by **A. Bruce Ritchie,** who for many years has acted as assistant to the vice-president in charge of mines at Trail, B. C.

OBITUARY

John Charles KempvanEe, Sr., pioneer California mining man, died recently at Los Angeles. He was 82 years old.

Thomas Burton Everett, retired mining engineer of California and Colorado, died recently at Sacramento, Calif.

W. E. Barron, mining engineer and geologist, died recently in Northern Rhodesia.

James Leslie Mennell, consulting mining engineer for Anglo-Huronian since 1929, died in Toronto on April 14.

Albert Joseph Seligman, president of the Butte Copper & Zinc Company, died on April 13 in New York City.

Dr. Harry Cyril Boydell, geologist and consulting mining engineer, died at Chester, N. S., on April 16; aged 56.

Raymond S. Bengson, geologist, a native of Colorado, was murdered by bandits recently near Matamoras, Mexico.

O. W. (Toby) Lewis, long identified with mining interests in the Coeur d'Alene district of Idaho, died recently at Wallace, Idaho, at the age of 53.

Major Henri Bettelheim, Rand pioneer and a contemporary of Rhodes, Jameson, and Beit, died recently in London.

Chester A. Hoatson, consulting mining engineer, formerly with Phelps Dodge and Calumet & Arizona, committed suicide in Phoenix on April 7. He was the son of Capt. Tom Hoatson.

William Brookings Sewell, retired copper mine operator of Quebec and Greenwich, Conn., died recently at sea while returning from an around-the-world tour. He was 61.

Claud Jeldness, mining engineer and geologist, who planted the American flag on the island of Spitzbergen and claimed it for the United States, died on April 24 at Spokane, Wash. He was 78 years old.

George Hall, veteran mining man, died at Salt Lake City, March 30, at the age of 90. For a number of years Mr. Hall was superintendent for Marcus Daly at Butte, and later superintendent of the Walker mine, at Walkerville, Mont.

Arthur Crowfoot, long associated with Anaconda and Phelps Dodge interests, was killed in an automobile accident on March 25. He was 62 years old. He came to the United States in 1894 and in 1895 entered the employ of Boston & Montana Consolidated, later merged with Anaconda. In 1914 he took charge of the company's new concentrator at Morenci. In 1922 Arizona Copper was taken over by Phelps Dodge, Mr. Crowfoot being retained in charge of concentrator operation. He remained with the Phelps Dodge interests in Morenci until the mines and plant were closed down. He then moved to Tucson and bought a ranch. When CWA became active in the vicinity he secured a position as assistant engineer with that body. Last year he was engaged by the Springtime Mining Company to design and construct a concentrator to handle the ores of the Old Pankey mine, near Hot Springs. He was driving an auto in the vicinity of that property when he met his death.

An Appreciation of L. C. Trent

Lamartine C. Trent, mining and mechanical engineer, who died in Auburn, Calif., March 9, 1935, at the age of 86 years, was born in London, England, and came to America when eleven years old. Professionally, he spent his entire life in the mining industry, visiting many mining regions throughout the world, and always was interested in improving the mechanical methods for recovering values from ores. His advice and help were given freely to any man engaged in the beneficiation of ores, and he was esteemed by all who came in contact with his lovable personality. A host of friends in California and elsewhere will mourn his passing.

In 1865 Mr. Trent enlisted in the Union army for service in the Civil War. After the war he went to the copper-mining districts of Michigan to demonstrate and sell Burley rock drills—a new device at that time for breaking down rock and ore in mining. While engaged in this work in 1874 he became acquainted with W. B. Frue, who had invented the vanner as a new method of concentration. Trent was present and assisted in the experiments and tests on the low-grade silver ores of the Silver Islet mine, on Lake Superior.

In 1878, the Frue vanner patents were secured by Frazer and Chalmers, of London, England, through their special agent, Mr. Walter McDermott, a well-known mining engineer, who came to the United States to observe the operation of the vanners. He became acquainted with Trent, and induced him to move to Denver, and open an office for his company to sell milling machinery.

Mr. Trent's outstanding contribution to the mining industry was his interest in extracting minerals from ores by concentration. He knew personally such men as W. A. Clark, J. B. Haggin, R. C. Chambers, George Robinson, John Hays Hammond, Pope Yeatman, D. C. Jackling, George O. Bradley, Otto Stallman, Charles Butters, and many other leaders in the mining industry.

Mr. Trent went to Australia in 1898 to develop a copper property for a London concern, and returned in 1901 to live in Palo Alto, Calif. In 1908, he took out a series of patents on an improved process of hydraulic sizing and classification, including chemical treatment of ores that were reduced to 200 mesh. This endeavor was a success, but with the decline of gold mining he interested himself in the treatment of Chilean nitrates and the separation of slate from coal. His studies resulted in a hydraulic concentrator, which was sold to the Hydrotator Company, of New York City, now in Cleveland, Ohio. In 1924, he returned to San Francisco and engaged in consulting work. In 1927, he retired and went to Auburn to live among the hills and in a climate he liked so well.

In 1879 he married Mary Delome McLeod, of Boulder City, Colo., and the family consists of five daughters and three sons, all living to mourn his passing, except Mark the eldest son. Walter E. Trent, well-known mining engineer, residing in Reno, Nev., is his natural successor. JOHN A. YEATMAN

LETTERS

Wanted, Basalt Specimens

The Editor:

For some time Dr. W. D. Urry has been testing the helium, radium, and thorium in the traps of the Keweenaw. From the ratio the age can be derived, as is more fully described in his paper. The results of the work are of unusual interest.

The Gogebic dikes are something like 560 million years old, the traps of the Champion mine, at the base of the series on Keweenaw Point, 550 million years, a core near the Atlantic Mine is 525 million years old, and the latest dike in the Horne Mine, Noranda, 510. Now, each of these results is subject to a probable error of something like 25 million years, owing to chemical limitations, but the probable error is either plus or minus, and the chance that it is purely accidental that these results come out in order of age is not great. These compare with an age of 170 million years for the Triassic trap. The Geological Society of America has appreciated these results so much that it has offered to support further investigations, especially in the younger rocks whose position in the geologic column is well known.

Though it seems that specimens from a fresh deep quarry surface or road cut may be of value, it would be better to have them from mines, and I am therefore appealing to your constituency for help. We would especially like freshly exposed fine-grained (not over one-tenth of an inch, two millimeters) rocks of a basaltic nature preferably (though it may be that the method can be applied to the andesites and rhyolites), taken from as far down in mines as possible, and with their geologic position practically assured.

We already have some fresh Miocene and Triassic material, but an early Tertiary (Laramie) basalt is desirable. In particular we should like some specimens from the Permian and from definite horizons in the Carboniferous and Devonian.

Dr. Urry is applying the method also to older Pre-Cambrian rocks. It seems likely that it will be of value in determining the relative dates of mineralization, but the Geological Society is particularly interested in testing the method by its results on rocks whose position is known. The application to the solution of unsettled problems is an interesting one, but I am not touching on this now.

ALFRED C. LANE,
Chairman Committee on the
Measurement of Geologic Time

Tufts College, Medford, Mass.

The Milburn Formula

The Editor:

Having occasion recently to estimate the cost of sinking a shaft, I was impressed by the lack of published information relative to the cost of shaft sinking. True, the costs of a limited number of specific shafts are available, but unfortunately details respecting the conditions under which they were sunk are often lacking. No one seems to have made any attempt, heretofore, to correlate the cost with the size of the shaft. If such a relationship does exist it would be of considerable aid to the engineer.

After studying the costs of a considerable number of shafts of various sizes and depths, which were sunk under various conditions, I have deduced the following formula for estimating the cost of shaft sinking:

$$C = K A^{0.05} \sqrt[5]{100 + D}$$

in which the symbols are

C = the cost in dollars per foot of depth.
K = a constant.
A = the cross-sectional area of the shaft, outside the timbers.
D = the depth of the shaft in feet.

The constant K is determined from the sum of the *six* variables found in the accompanying table.

The amount of water is an important factor. The term "average" implies that the inflow is sufficient to necessitate pumping or bailing, but not enough to impede sinking operations seriously. The factor 0.10 is used when it is expected that the shaft will be dry for the greatest part of its depth. When the inflow of water is expected to be a handicap to sinking operations the factor is taken from the third column.

The variation in cost of supplies is not usually an important item. The cost may be lowered, for example, by proximity to a supply of timber or by using salvaged material. It may be slightly greater in remote localities.

• When the expectation is that little timber will be used except for guides and manways, the factor in the first column is used. "Average amount of timber" means that the sets are to be spaced 5 or 6 ft. apart and the ground is not heavy.

The hardness of the ground does not affect the total cost of the shaft to a great extent, for, as a rule, the increased drilling costs are offset by the reduced amount of timber necessary. The factor in the third column is used when the hardness of the rock necessitates the use of more powder, with noticeably increased drilling costs.

The term "average efficiency of labor" implies that good shaftmen are used and a bonus is paid for speed. The highest factor is used when the work is done under straight day labor; and the lowest factor for highly skilled labor working under the bonus or contract system.

In most shafts the factor 0.20 can be taken as the factor for contingencies. It is increased when the ground seems likely to cave or when other conditions appear to warrant it. The contingency factor is decreased when unusually smooth and unhindered operations are expected—an ideal seldom obtained.

This formula includes all items of cost that are chargeable directly to sinking operations, and a reasonable overhead charge. It does not include pockets, stations, permanent air pipes, and pumping columns, or surface equipment other than small temporary structures used in connection with sinking operations.

I do not claim that the formula will give the true cost of a shaft that has been sunk, or is to be sunk, even when the factor K can be accurately determined and the costs known closely, because that uncertain personal equation must ever remain, both in using formula and in sinking the shaft. However, I do believe that the cost of a proposed shaft can be estimated by its use with tolerable accuracy; and that it will at least give results as satisfactory as any other method in use, and with considerably less mental fatigue.

Criticism of the formula by others may suggest a revision of the formula and a better method of determining the factor K.

T. H. MILBURN.

Shaft-Sinking Data

Company—See Footnote	Shaft	Year	Formation	Ground	Water, G.p.M.	Compartments	Rock Section, Feet	Area, Sq.Ft.	Depth, Feet	Size Timber, Inches	Cost Supplies	Total Cost	Computation of K: Water	Supplies	Timber	Labor	Rock	Contin.	K	Computed Cost	Per Cent of Error
1(a)	No. 5	1925–28	Sedimentary —diabase	Firm to slabby	Yes	4	8 x21	168	2,531	10 x10	$28.01	$104.50	.25	.02	.12	.15	.03	.20	.77	$104.50	0
1(a)	No. 6	1930	Dacite	Firm	5	3	7½x16½	124	1,226	10 x10	20.75	79.28	.20	.02	.12	.15	.03	.20	.72	70.00	—12
2(a)	No. 4	1930	Andesite	Swelling	80	3	8½x19	161	495	10 x10	24.00	83.78	.30	.02	.10	.15	.01	.25	.83	81.00	— 3
3(a)	No. 3	1931	Basalt	Easily Broken	0	2.5	8 x14	112	445	.....	11.12	47.00	.10	.02	.12	.15	.01	.20	.60	46.00	— 2
4(a)	Jim Crow	1929–30	Andesite	Medium	...	3	6½x16	104	1,720	8 x 8	15.17	56.62	.15	.02	.10	.15	.02	.20	.64	58.00	+ 2
5(a)	Water Lily	1921	Rhyolite Limestone	Soft	...	3	18½x 6½	120	1,325	8 x 8	16.52	57.71	.15	.02	.12	.10	.01	.20	.60	57.00	— 1
6(a)	.....	1928	Limestone	Medium	...	1	5 x 7	35	260	2 x 4	4.43	15.63	.15	.02	.05	.15	.02	.20	.59	19.00	+21
7(a)	Bisbee Queen	1927	Limestone	Hard	...	...	8 x17	136	800	8 x 8	.....	69.15	.15	.02	.12	.15	.03	.20	.67	64.00	— 7
1(c)	No. 7	Recent	.....	.....	...	...	7½x16½	124	1,465	.....	.....	70.00	.15	.02	.12	.15	.02	.20	.66	66.00	— 6
8(d)	.....	Recent	.....	Medium	...	...	8 x17	136	1,000	.....	.....	65.00	.15	.02	.12	.15	.02	.20	.66	65.00	0
9(e)	Pim	1922–23	Limestone	Medium	70	3	6 x20	120	730	8 x 8	33.11	76.17	.30	.02	.12	.15	.02	.20	.81	70.00	— 8
10(d)	Mine No. 2	.....	Limestone	.....	0	...	5 x 7	35	260	In part	.....	18.86	.10	.02	.08	.15	.02	.20	.57	18.70	0
10(f)	.....	.....	Limestone	.....	0	...	5 x 7	35	272	In part	.....	22.86	.10	.02	.08	.15	.02	.20	.57	18.80	—17

1, Magma Copper; 2, Christmas Copper; 3, U.V.X. Mining; 4, Calumet & Arizona; 5, Walter Fitch, Jr., Co.; 6, Average of three shafts—Tri-State district; 7, Bisbee Queen; 8, Hypothetical; 9, National Lead; 10, Tri-State district.

(a) U. S. Bureau of Mines, I.C. 6168. (b) Considerable water. (c) U. S. Bureau of Mines, Bulletin 357. (d) M. J. Elsing, *E. & M. J.*, Vol. 132, page 349. (e) I. C. 6588. (f) I.C. 6591.

NEW BOOKS

The Copper Cycle

PRODUCTION AND PRICE OF COPPER. *By Charles Louis Knight. University of Pennsylvania Press, Philadelphia. Pp. 153. Price $2.*

According to the author, the material in this book has been gathered to analyze the secular and cyclical movements in copper production and copper prices, and the study is purely historical in nature. Data collected for the study cover the period 1860 to 1930. The findings are much in harmony with what traders have long known, perhaps instinctively—namely, that the demand for copper moves in close harmony with the major cyclical movements in general business activity. Mr. Knight observes that the price of copper, despite numerous attempts at centralized control, has been determined in the long run by the relationship between the supply and demand.

Introduction to Minerals

GETTING ACQUAINTED WITH MINERALS. *By George Letchworth English. Mineralogical Publishing Company, Rochester, N. Y. Pp. 324. Illustrations, 258. Price $2.50 net, $2.65 post free.*

Written primarily for the beginner in the study of mineralogy, and designed not only to arouse but also to sustain interest in the subject, this book will, nevertheless, be welcomed by the advanced student and the professional on account of its orderly and simple presentation. The author has devoted a lifetime to the study, collection, and distribution of minerals, and now contributes from his store of knowledge an exceptionally readable book of information. His enthusiasm is contagious and his style inviting, so that the reader is led by logical but imperceptible steps from one chapter to another, finally gaining a broad comprehension of one of the most attractive natural sciences. The book achieves the author's expressed purpose "to introduce the charming science of mineralogy in the simplest and most interesting manner possible, without sacrificing scientific accuracy."

The first part of the book contains a fascinating discussion of the properties of minerals: hardness, tenacity, crystalline forms, cleavage, fracture, and phenomena with respect to light, electricity, and magnetism. Profuse photographic illustration marks these pages. The remainder of the book is devoted to the description of minerals and rocks, tables for the identification of minerals, and a pronouncing vocabulary. A good index completes the work.

A PRIMER OF MONEY. *By Donald B. Woodward and Marc A. Rose. Whittlesey House, McGraw-Hill Book Company, New York. Pp. 322. Illustrated. Price $2.50.*

The authors have revised and greatly enlarged their book on this subject first published in 1932, and have consolidated it with their other book, "Inflation." Swiftly moving events in monetary and banking matters have made necessary a further clarification of the somewhat bewildering scene enacted since the first edition was published. No departure has been made from the authors' first purpose to write for the layman who is likely to become confused by other literature on the subject written in the jargon of the expert. This book is in every sense a primer, written in simple English—an ABC on the subject of money, factual and authoritative. The reader will find it entertaining as well as instructive.

MARKETING INDUSTRIAL EQUIPMENT. *By Bernard Lester. Published by the McGraw-Hill Book Company, New York. Pp. 307 (6x9 in.), illustrated. Price $3.50.*

Mr. Lester's work approaches the subject of distributing machinery and industrial supplies "from the point of view of sales effort directed toward a solution of the problems which the prospective customer must meet. It gives the sales engineer and business man an insight into the difficulties to be overcome and provides a method for analyzing them which should lead to greater effectiveness and increased economy." The author is assistant sales manager of the Westinghouse Electric & Manufacturing Company, lecturer at the University of Pittsburgh, and a member of the American Marketing Society and the American Management Association.

GAS-, COKE-, AND BYPRODUCT-MAKING PROPERTIES OF AMERICAN COALS AND THEIR DETERMINATION. *By A. C. Fieldner and J. D. Davis. Bureau of Mines Monograph 5. Printed by American Gas Association, New York.*

This monograph presents a cooperative study by the Bureau of Mines and the American Gas Association of those properties of coal pertaining to the manufacture of gas and coke, as distinguished from the better-known properties affecting the use of coal for generation of heat and power. The contents cover the examination and carbonization tests of 30 coals by the BM-AGA method, the relation of chemical and physical tests of coal to coking properties and byproduct yields, and the recommended procedure for determining the gas-, coke- and byproduct-making properties of coals.

Publications Received

Annual Report of the Quebec Bureau of Mines for 1933. Part C. Two papers: McWatters Mine Gold Belt, East Rouyn and Joanne's, by J. E. Hawley, and Beattie-Galatea Mines Map Area, Duparquet Township, by J. J. O'Neill. Quebec, Canada. Pp. 114.

Territory of New Guinea and of Papua, 1934. A map, 24x36 in. Commonwealth Government Printer, Australia. Obtainable for 3 shillings (60c.) from Prime Minister's Department, Canberra, F. C. T., Australia.

Mother Lode Gold Belt of California. By Clarence A. Logan. Bulletin No. 108. State Division of Mines, San Francisco. Pp. 240.

California Journal of Mines and Geology. (Quarterly Chapter of State Mineralogists' Report XXX. Pp. 303-487.)

Placer Mining in the Western United States. Part III. Dredging and Other Forms of Mechanical Handling of Gravel, and Drift Mining. By E. D. Hardner and C. H. Johnson. I. C. 6788, U. S. Bureau of Mines, Washington, D. C. Pp. 81.

Mining Methods and Costs at the Mine of the St. Joseph Lead Co., Atlanta, Idaho. By E. D. Gardner, I. C. 6823. U. S. Bureau of Mines, Washington, D. C. Pp. 7.

Joseph A. Holmes Safety Association and Its Awards. By D. Harrington. I. C. 6831. U. S. Bureau of Mines, Washington, D. C. Pp. 100.

Mining and Milling Methods at Big Jim Mine, Oatman, Ariz. By C. H. Johnson. I. C. 6824. Pp. 13.

Mineral Physics Studies (eight papers). By R. S. Dean and others. R. I. 3268. U. S. Bureau of Mines, Washington, D. C. Pp. 107.

Recent Trends in Man-Hour Production at Iron Ore Mines. By H. W. Davis, W. W. Adams, and O. E. Kiessling. R. I. 3266. U. S. Bureau of Mines, Washington, D. C. Pp. 6.

Safety Posters at the Calumet & Hecla Mines. By F. S. Crawford. I. C. 6827. U. S. Bureau of Mines, Washington, D. C. Pp. 9.

Great Bear Lake to Rae, Northwest Territories. Preliminary Geological Report. By D. F. Kidd, Geological Survey, Department of Mines, Ottawa, Canada. Pp. 14.

Theory and Use of the Metallurgical Polarization Microscope. By Russell W. Dayton. Bulletin 50, Rensselaer Polytechnic Institute, Troy, N. Y. Pp. 32.

Mineral Production of Ontario, 1934. Preliminary Report. Department of Mines, Toronto. Pp. 31.

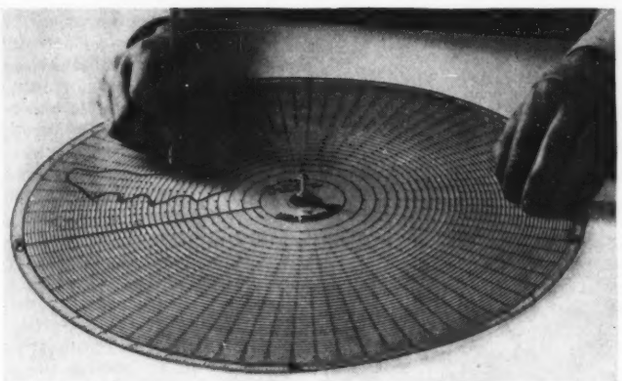
EQUIPMENT NEWS

A Device for Measuring Irregular Areas

Intended Originally by the Inventor for Use on Aerial Mosaic Maps, It Is Now Suitable for Work on Any Surface

• For all work in the engineering office where irregular areas on maps and drawings have to be measured, a new device, known as the Rotometer, which has been developed by Aerial Explorations, Inc., can be read directly to hundredths of a graduation.

The theory of the instrument is based on the strip method of area determination, each circle representing the center



This device for measuring irregular areas is based, in theory, on the strip method of area determination. The disk is made of specially selected material that has uniform shrinkage

of New York, will be found of service. The invention was originally intended to be used for measuring the areas of mosaic maps, where the joint lines prohibited the use of a planimeter. In its present finished form, the instrument may be applied to any area-measuring task on any kind of surfacing.

It consists of a transparent disk, made from a special acetate stock that has uniform shrinkage. On the disk is inscribed a series of concentric circles spreading out to a margin which is calibrated on the standard model, in square inches, and on special models, in any desired unit of area measurements.

The disk is placed over the map or drawing so that the area to be measured lies with its inner and outer boundaries approximately halfway between any two adjacent circles. A pencil mark or pin prick is made at the point where the zero of the outer scale chances to fall. Then, using a pointed instrument, pin or needle, placed at the intersection of the inner boundary of the area and the rotometer circle, the disk is rotated counter-clockwise until another boundary and circle intersection is reached. This procedure is repeated with the successive circles until the entire area is covered, when the graduation on the scale opposite the mark made at the starting point is read. This outer scale line of a narrow strip which in full circumference measures, on the standard disk, 5 sq.in.

The Rotometer is made in four sizes: 7 in. diameter, 1 sq.in. per revolution; 11 in. diameter, 2 sq.in.; 17 in. diameter, 5 sq.in.; large size, 200 sq.in.

Fireless Locomotive Now Available In Geared Type

• What is said to be the first and only geared fireless locomotive in the United States has been built by the H. K. Porter Company, of New York, for the New York Navy Yard. It weighs 103,000 lb., has two 16x16-in. cylinders and a 600-cu.ft. storage tank fusion-welded into a single one-piece unit which is built for 200-lb. working pressure. It has a normal drawbar pull of 18,000 lb. and a maximum pull of 26,000 lb. By virtue of the geared drive the torque is steady so that the locomotive does not slip its wheels as readily as does the direct-connected type. Comparative tests are said to show that it will do over 35 per cent more work than the direct-connected type on one charge of steam.

The new locomotive has two cylinders, the pistons of which drive the jack shaft through a single-gear reduction, which in turn connects with the driving wheels through cranks and side rods. The gears are made of nickel alloy steels containing 1.20-1.70 per cent nickel, 0.60-1.00 chromium and 0.40-0.50 carbon, and were heat-treated to show a scleroscope hardness of 55 to 60, equivalent to 380-430 Brinell. Timken roller bearings are used on all shafts and driving axles.

This type of locomotive has neither boiler nor firebox. Instead, it carries a tank containing water, which is heated by steam from a suitable stationary boiler. To insure dry steam the storage tank is only four-fifths filled with water. It is specially lagged and jacketed to prevent loss of heat. As steam is used up, the temperature of the water and the steam pressure in the tank are gradually lowered and part of the water turns into steam.

The fireless locomotive is available for all steam pressures of 100 lb. or more. Chief among its advantages is the complete elimination of fire hazard and smoke nuisance. One man only is required for running it.

Air Hose Built to Compensate Unequal Stresses

• A new air hose, possessing the advantages of both wrapped duck and braided hose, with none of their weaknesses, has been developed by the Manhattan Rubber Manufacturing Division of the Raybestos-Manhattan, Inc., Passaic, N. J. By means of a new type of construction, the unequal ply stresses set up in the wall of the hose by longitudinal and lateral tension incident with operation are compensated and made equal. This is accomplished solely within the unique construction, which involves the use of two strength members; namely, a braided cord member for longitudinal stresses, and a spiraled strength member for expansion and lateral stresses, both of which are welded in tough, age-resisting rubber. In this way, internal friction and chafing are said to be eliminated. The material thus fabricated resists surge and pulsation effectively. The hose is said to be so strong that present-day working pressures can be completely disregarded.

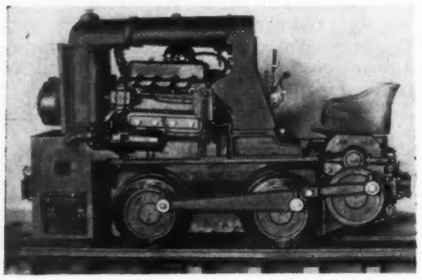
New Alloy Steel Resists Abrasion, Is Easily Machined

• Demand for an alloy steel that is not only hard and tough but also possesses the maximum ductility consistent with hardness so as to facilitate machining, drilling, and bending, is said to be fully met in a new alloy steel recently introduced by Joseph T. Ryerson & Company, Inc., Chicago. When compared with commercial soft steel plate, bars, and the like, and even with higher straight carbon steel products, the new product is said to give two and a half times longer life, where resistance to

wear and abrasion is concerned. The nature of the application will determine the actual comparative life, which is also influenced by the methods of fabrication employed as well as by the occurrence of high shock stresses. Among other applications it is used for chute lining, liners and hammers for pulverizers, bucket lips, and for dredge pipes and similar devices. It comes in plates and sheets in No. 16 gage ranging from 36x96 in. to 72x360 in., ½-in. thick. It may also be had cut in circles or irregular shapes.

New Diesel Locomotive for Mines Built in United States

• In the accompanying cut is shown an American-built diesel locomotive intended for underground service. The Ruth Company, of Denver, which manufactures it, claims that the carbon monoxide content of its exhaust gases is zero at half, three-quarters, and full load and that the CO_2 content ranges from 5 to 9.8 per cent for the same loading, and points out that the United States Bureau of Mines in its Information Circular 6732 has approved diesel locomotives for underground use. Where circumstances require it, the company furnishes a scrubber which removes all odor. The locomotive develops 40 hp., with five speeds in either direction, varying from 1 to 12 miles per hour and 2,000-lb. drawbar pull. The same manufacturer is also building a "trammer" of 800-lb. drawbar pull with a maximum speed of 5 miles per hour.



This diesel locomotive produces no poisonous gases, as shown by analysis of samples taken at half, three-quarters, and full load

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High-Intensity Mercury Lamp For Better Lighting

• A new high-intensity mercury-vapor lamp, suitable for high bay lighting, has been perfected by the General Electric Vapor Lamp Company, Hoboken, N. J. It gives an industrial white light restful to the eye, and is unusually efficient in that it produces 14,000 lumens at a consumption of 400 watts, or approximately 35 lumens per watt. It is 13 in. long over all, mounted vertically, and designed for 110-volt and 220-volt 60-cycle circuits. Its average life is 1,500 hours. Its light is not really white but is a combination of blue and yellow-green which produces a whiter sensation to the observer.

Two-stage Compressor Has Four Low-pressure Cylinders

• Following the modern trend toward increase in the amount of delivered air, lower power consumption and longer compressor life, engineers of the Gardner-Denver Company, Quincy, Ill., have developed a new six-cylinder two-stage water-cooled compressor embodying distinctive features. An outstanding departure from conventional design is the use of four small-diameter low-pressure cylinders, instead of two large ones, this construction permitting the use of small, light-weight pistons and considerably reducing the inertia loads. It also provides lower air temperatures than previously obtained in small vertical compressors, with corresponding saving in horsepower. By water-cooling the cylinder walls, lower wall temperatures are obtained, with better lubrication and longer life. Distortion of walls from heat is eliminated and the compressor works independently of atmospheric temperatures.

Motorized Grab Bucket Uses Only Two Conductors

• Improved motor-driven grab buckets, ranging from ½- to 3-cu.yd. capacity, for use with bulk materials, such as ore, limestone, dolomite, slag, sand, cinder, and coal, have been introduced by the Erie Steel Construction Company, of Erie, Pa. By reason of the adoption of special d.c. Westinghouse control, the use of only two conductors is possible between the control cab and the bucket. Inasmuch as each bucket carries its own motor, it can be attached to a crane, monorail hoist, or other hoisting equipment where electric power is available. It is ready for work as soon as the hoist-block hook has been slipped into the holding yoke and an electrical connection has been made by a plug. Power is supplied either through a loop cable or a cable paid out from a light-weight drum. The unit is self-contained and lubricated by a forced system. The capacity of the bucket is said to be much greater than that of other mechanical hook-on types.

Safety Cap Designed for Comfort, A Non-conductor

• Resembling the old-style miner's cap in appearance and comfortable fit, a new safety cap recently introduced by Mine Safety Appliances Company, Pittsburgh, Pa., is said to possess all the desirable protective qualities of the company's Skullgard line. The cap is molded in one piece from durable black micarta and is reinforced at the top of the crown by a completely insulated metal-screen and ribbed construction, and at the base by an integrally molded tape that extends into the peak of the cap. The peak is sufficiently long to shield the wearer's eyes from the light of other lamps, the maker asserts, and gives added protection to face and eyes from falling and flying material. The lamp holder base is an integral part of the crown and is provided with a nickel clip for the Edison cap lamp as standard equipment. A special holder is available for other types of lamps upon specification.

The new cap will not conduct electricity and is said to be immune from softening by mine water or perspiration. It is available in one-eighth sizes from 6 to 7¾, inclusive, and has a renewable sweatband of untreated leatherette or genuine leather, as desired. The wearer's head is cushioned by an adjustable hammock of strong webbing which absorbs and distributes the shock of loads falling on the crown. Self-ventilation is provided by holes in the crown and spaced around the sweatband.

Hot Material Belting Improved, Giving It Longer Life

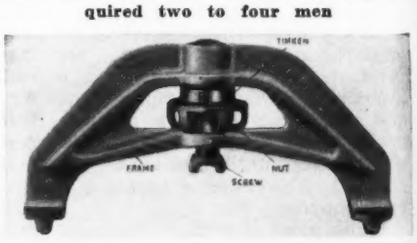
• Various improvements in construction are said to impart to a new hot material belt made by the B. F. Goodrich Company, Akron, Ohio, a flexing life that is 80 per cent greater than that of regular grades of hot material belting. The new belt is known as Golden Ply. Its cover is so made as to offer greater resistance to abrasion than do the regular grades, even after prolonged exposure to heat. It is said to show an increase of 31 per cent in flexing life in normal aging tests (fourteen days at 158 deg. F.), as compared with a reduction of 15 per cent in the case of usual hot material belting.

Another product recently announced by the same manufacturer is the so-called Plastikon putty, a compound similar in appearance and consistency to ordinary painter's putty, with the exception that it is combined with rubber. In addition to having the usual characteristics of ordinary putty, this new compound is said to eliminate mixing, as it contains practically no oil; also to resist chemical fumes and moisture effectively and to possess a high degree of adherence to steel surfaces.

Rail Benders of Aluminum Speed Track Work

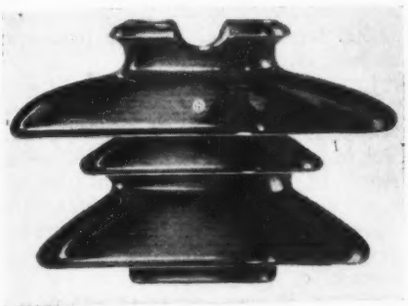
• Made of aluminum, the rail bender shown in the accompanying illustration requires but one man to bend 30- to 60-lb. rails, as compared with two to four men when using a tool of an obsolete type. This particular model, which is made by the Utility Conveyor & Mine Equipment Company, 620 Tower Grove Ave., St. Louis, Mo., is so designed that it can be set in half the usual time by the spin of a nut. A bender for 15- to 25-lb. rails weighs 20 lb.; for 25- to 40-lb. rails, 24 lb.; and for 40- to 60-lb. rails, 44 lb. These benders are equipped with a Timken thrust bearing. Jack pipes of half the usual weight are also available.

This rail bender is so light that its use enables one man to do what formerly required two to four men



Strong Insulators to Avoid Heavy Replacements

• To meet the demand for a one-piece pin-type insulator equivalent in size and electrical values to comparable insulators normally used on transmission lines of from 22 to 46 kv., Ohio Brass Company, Mansfield, Ohio, offers three "O-B Uni-Part" insulators Nos. 31546, 31622, and



The sturdy construction of this insulator makes it especially suitable for locations where such equipment is subject to frequent breakage

31623. These insulators, the manufacturer states, are exceptionally strong and are especially adapted for use on line locations where replacements are heavy because of breakage due to shooting, stone-throwing or mechanical impacts.

Frequency Changer Hydrogen-Cooled For First Time

• The first frequency changer in which are incorporated the advantages of operation in a hydrogen atmosphere has been completed by the General Electric Company. It will convert 60-cycle, three-phase power to 25-cycle, three-phase power for use at the Bethlehem Steel Company's plant at Bethlehem, Pa. The motor of the new set is a 24-pole, 12,000-volt, 300-r.p.m. machine rated at 23,500 kva. at 0.9 power factor. The generator has 10 poles, and at 6,900 volts, 0.9 power factor, will deliver 22,222 kva. Hydrogen is a more efficient cooling agent than air, permitting a saving in size for the same power rating. With it, the windage loss is about 10 per cent of that with air and the tendency for the formation of corona is eliminated.

Resilient Ribs of New Gasket Make Tight Joint

• Designed to produce perfect tautness with only 30 per cent as much contact surface as on a plain, flat metal gasket, the new Multiseal gasket made by Goetze Gasket & Packing Company, New Brunswick, N. J., is said to withstand extreme pressure, temperature change, and vibration. This is accomplished by providing the faces with crossed ductile and resilient raised ribs, which under very small bolt pressure are said to set themselves into tight contact even on imperfect flange faces. These gaskets are more resilient than flat, solid metal gaskets. They are available in solid copper, steel, Armco iron, aluminum, or lead, or as a metal shell with asbestos filler, and in any circular, elliptical, or special shape.

Resurfaces Plant Floors Quickly

• For repairing within 36 hours, floors of concrete, wood, brick, asphalt, or composition that have become rutted, rough, or broken, Stonhard "Resurfacer" is offered by the Stonhard Company, 401 North Broad St., Philadelphia, Pa. According to the company, the material can be applied with a trowel without extensive preparation, and provides a tough, resilient, dust- and waterproof non-skid surface.

Carbide Light for Emergencies Economical With Charge

• A new carbide light weighing only 40 lb. when fully charged, and which burns for three hours, giving 8,000 candle power, has been developed by the National Sales Corporation, New York. Announced as a police emergency light, it has many other applications. The light may be shifted to any angle and may be folded down for carrying. The unit is 3½ ft. high, extended for use, and 28 in. when folded. A 1¾-lb. charge of carbide is sufficient for over three hours. The light may be operated intermittently, as needed, without the waste of any of the charge. By throwing a lever, the carbide is relased a few grains at a time into the water tank below, the rate of feed being regulated automatically by the gas pressure.

Refaces and Re-edges Tools At Cost Saving

• A new arc-welding electrode, designed for restoring worn cutting edges on tools of all kinds, and which is said to permit savings of 20 to 25 per cent in tool cost, has been announced by the Lincoln Electric Company, Cleveland, Ohio. This new electrode, known as "Toolweld," can be used to give lathe tools, bits, milling cutters, drills, cutting and forming dies, and all other tools which have become worn in service, a new and harder cutting edge than has heretofore been possible. Such tools can be refaced an unlimited number of times with this electrode. By means of it a deposit equivalent to that of high-speed tool steel can be made. The material treated retains its hardness (55 to 65 Rockwell C) under temperatures up to approximately 1,000 deg. F.

Power Pump Designed to Give Minimum Foundation Cost

• Some unusual features are incorporated in the 18-in. stroke, totally inclosed, horizontal, duplex power pump which has just been introduced by Worthington Pump & Machinery Company, Harrison, N. J. Its design is strictly modern. The power end is self-contained and is supported on the foundation throughout its length, being designed to minimize the foundation cost.

INDUSTRIAL NOTES

• Western Machinery Company and J. E. Knapp Company, of San Francisco, have contracted to supply the equipment and erect the new 1,100-ton cyanide plant for the Anglo American Mining Company, to work the Yellow Aster tailings at Randsburg, Calif. Hamilton, Beauchamp & Woodworth are the metallurgical engineers. Roy C. Marcellus will be in charge of erection and installation for J. E. Knapp Company.

• Oliver United Filters, Inc., announces that, after completing work in Australia, A. R. Duvall spent the last three months in Manila in checking over the operation of Oliver equipment in the Philippines. He has now gone to Japan, where he will make his headquarters with Andrews & George Company, Inc., of Tokyo. During his stay there he will visit the numerous Oliver filters installed in that country.

• Halafax Explosives Company has started its new plant near Saugus, southern California, where it will produce a full line of explosives.

• Foxboro Company, Foxboro, Mass., has been appointed sole distributor of "Commercial" orifice fittings, made by the Commercial Iron Works, of Los Angeles. In consequence, it announces that it can now supply a complete meter set-up more successfully, in addition to the obvious advantages of securing undivided responsibility for an entire metering set-up.

BULLETINS

Instruments for Spectrographic Analysis. Bausch & Lomb Optical Co., Rochester, N. Y. A 54-pp. pamphlet of information for experienced physicists, chemists and researchers who are already familiar with the spectrograph but who need detailed descriptions of the instruments to guide them in selection, also for analysts and researchers who know little of spectrographic methods but are keenly interested in any device that will extend the range of accurate analysis.

String Discharge Filters. Filtration Engineers, Inc., 858 Summer Ave., Newark, N. J. A handsomely illustrated 8-pp. booklet entitled "Getting the Cake on Strings."

Pulverizing Equipment. Raymond Bros., Impact Pulverizer Co., Chicago. The Raymond Review, 1934. Pp. 8.

Electric Welding. Ideal Electric & Manufacturing Co., Mansfield, Ohio. Bulletin 910. The Noel Speed Arc Welder. Pp. 15.

Wood Preservation with Creosote. Tennessee Eastman Corporation, Kingsport, Tenn. A pamphlet on the use of "NO-D-K" natural wood creosote. Pp. 16.

Transmission Cable. General Cable Corporation, New York. Bulletin LS-1, entitled "Why the Vacuum Process Lead Sheath Has No Critical Region." Pp. 12.

Mine Safety Equipment. Mine Safety Appliance Co., Pittsburgh, Pa. M-S-A equipment for pits and quarries. Pp. 8.

Mill Linings, Grinding Balls. Patterson Foundry & Machine Co., East Liverpool, Ohio. Leaflet on Porox 66. Pp. 4.

Ore-Dressing Notes. American Cyanamid Co., 30 Rockefeller Plaza, New York. Leaflet 401. Two articles: "Use of Corduroy in Gold Ore Treatment" and "Milling Developments at Benguet Consolidated Plant." Pp. 12.

Grinding Mills. Traylor Engineering & Manufacturing Co., Allentown, Pa. Bulletin 1103. Pp. 34.

Metallic Zinc Powder in Industrial Paint. New Jersey Zinc Sales Co., New York. Pamphlet. Pp. 16.

Brazing Flux. Handy & Harman, New York. Leaflet on "Handy Flux" for steel, stainless steels, nickel, copper, brass and other alloys. Pp. 4.

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

MARKETWISE, it may be said that the month of April had a silver lining. The open-market quotation for the metal advanced 14½c. per ounce during this brief period. Quite early in the month it became apparent that speculators operating abroad were competing for the rather limited floating supply, which greatly strengthened prices. The world price touched 81c., New York, April 26, the highest quotation since Nov. 10, 1920. The sensational rise brought out two advances in the United States Government's buying price of newly mined domestic silver. The first official revision occurred on April 10, establishing the price at 71.11c., and the second change became effective April 24, on which date the quotation was raised to 77.57c.

Believing that the Government would stop at nothing short of $1.29 per ounce, foreign operators continued to bid the market upward. However, nothing was done in Washington after April 24, for it became known that the rapid rise threatened to embarrass foreign countries utilizing silver as currency. The fact that the United States decided not to follow the world price at any cost discouraged traders abroad, and the price eased considerably as the month ended. Observers in Washington believe that the Government's silver program will be continued, but at a slower pace.

Foreign copper advanced moderately, spurred by the recent international agreement on production and marketing. The buying abroad was good, but not so active as in the preceding month. The domestic market for copper quieted down a little on some uncertainty over future NRA policy, particularly in reference to fabricated copper products. Domestic sales of "Blue Eagle" copper during April amounted to 26,700 tons, against 32,300 tons in March. The price was unchanged.

Lead shipments during April were large, consumers ordering more metal into their plants prior to the advance in freight rates that became effective on April 18. Refined lead statistics for April are expected to be favorable. The price settled at 3.75c., New York, a net gain of 10 points. Buying was in good volume.

Prime Western zinc advanced 20 points on curtailed production and some encouraging business from galvanizers. With concentrate at $26 per ton, producers of metal are striving to raise the price further to cover all charges.

Our index of non-ferrous metal prices for April was 74.73, against 71.36 a month previous.

United States Market

1935 April	Electrolytic Copper Domestic (a)	Electrolytic Copper Domestic (b)	Electrolytic Copper Export (c)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
1	9.00	8.775	7.100	47.250	3.65	3.50	3.900
2	9.00	8.775	7.075	47.950	3.65	3.50	3.900
3	9.00	8.775	7.025	48.500	3.65	3.50	3.900
4	9.00	8.775	7.150	49.350	3.65	3.50	3.900
5	9.00	8.775	7.250	49.600	3.65	3.50	3.900
6	9.00	8.775	7.325	49.400	3.65	3.50	3.900
8	9.00	8.775	7.425	49.450	3.65	3.50	4.000
9	9.00	8.775	7.425	49.400	3.65	3.50	4.000
10	9.00	8.775	7.400	49.550	3.65	3.50	4.000
11	9.00	8.775	7.375	50.750	3.65	3.50	4.000
12	9.00	8.775	7.425	51.250	3.65	3.50	4.000
13	9.00	8.775	7.450	51.250	3.65	3.50	4.050
15	9.00	8.775	7.425	51.000	3.70	3.55	4.050
16	9.00	8.775	7.400	51.125	3.70	3.55	4.05@4.10
17	9.00	8.775	7.375	50.750	3.70	3.55	4.100
18	9.00	8.775	7.400	50.625	3.70	3.55	4.100
19	9.00	8.775	7.400	50.625	3.70	3.55	4.100
20	9.00	8.775	7.400	50.625	3.70	3.55	4.100
22	9.00	8.775	7.400	50.750	3.75	3.60	4.100
23	9.00	8.775	7.375	50.825	3.75	3.60	4.100
24	9.00	8.775	7.375	50.950	3.75	3.60	4.100
25	9.00	8.775	7.325	50.750	3.75	3.60	4.100
26	9.00	8.775	7.300	50.500	3.75	3.60	4.100
27	9.00	8.775	7.300	50.500	3.75	3.60	4.100
29	9.00	8.775	7.300	50.375	3.75	3.60	4.100
30	9.00	8.775	7.325	50.900	3.75	3.60	4.100
Av. for month		8.775	7.328	50.154	3.692	3.542	4.030
Averages for Week							
3		8.775	7.050	47.763	3.650	3.500	3.900
10		8.775	7.329	49.458	3.650	3.500	3.950
17		8.775	7.408	51.021	3.675	3.525	4.046
24		8.775	7.392	50.733	3.725	3.575	4.100
Calendar Week Averages							
6		8.775	7.154	48.675	3.65	3.50	3.900
13		8.775	7.417	50.275	3.65	3.50	4.008
20		8.775	7.400	50.792	3.70	3.55	4.088
27		8.775	7.346	50.713	3.75	3.60	4.100

Silver, Gold, and Sterling Exchange New York and London

1935 April	Sterling Exchange "Checks"	Sterling Exchange "90-day Demand"	Silver (d) New York	Silver London	Gold London	Gold (e) United States
1	4.78875	4.78500	61.250	28.4375	145s 8½d	$35.00
2	4.81000	4.80625	61.250	28.2500	144s 1 d	35.00
3	4.80500	4.80125	61.250	28.3750	145s 7½d	35.00
4	4.83500	4.83125	61.500	28.3125	144s 3 d	35.00
5	4.85875	4.85500	61.750	28.3125	143s10½d	35.00
6	4.84500	4.83875	62.250	28.4375	144s 1 d	35.00
8	4.83375	4.82625	62.625	28.4375	144s11 d	35.00
9	4.84000	4.83250	63.000	28.8125	144s 1½d	35.00
10	4.84250	4.83125	64.125	28.9375	143s 6 d	35.00
11	4.84250	4.83375	65.750	29.6875	143s11½d	35.00
12	4.83750	4.82875	68.500	31.3125	144s 1 d	35.00
13	4.84500	4.83750	68.500	31.3125	144s 2½d	35.00
15	4.84750	4.84000	68.250	31.2500	143s11 d	35.00
16	4.85500	4.84750	67.250	30.9375	143s 4 d	35.00
17	4.84875	4.84000	67.000	30.7500	143s 4 d	35.00
18	4.84750	4.84000	67.625	30.9375	143s 7 d	35.00
19	4.84875	4.84000	67.625	——Holiday——		35.00
20	4.84750	4.84000	67.625	——Holiday——		35.00
22	4.84625	4.83875	67.625	——Holiday——		35.00
23	4.84500	4.83750	69.875	32.3750	143s 6 d	35.00
24	4.83625	4.83000	71.625	32.8125	143s 8½d	35.00
25	4.83000	4.82250	77.000	34.8750	144s 5 d	35.00
26	4.81000	4.80250	81.000	36.2500	144s 9½d	35.00
27	4.82250	4.81500	76.750	35.1250	145s 4 d	35.00
29	4.83500	4.82875	75.750	34.0625	144s 5½d	35.00
30	4.83125	4.82375	75.750	34.6875	144s 8 d	35.00
Av. for month	4.83596	.....	67.788	30.986	.....	35.00
Averages for Week						
3	4.80521	.....	61.125	.....	.....	.....
10	4.84250	.....	62.542	.....	.....	.....
17	4.84604	.....	67.542	.....	.....	.....
24	4.84521	.....	68.667	.....	.....	.....

Calendar week averages: New York Silver April 6th, 61.542; 13th, 65.417; 20th, 67.563; 27th, 73.979.

(a) Quotation issued by the Code Authority for copper offered for sale in domestic market pursuant to provisions of Copper Code.

(b) Net prices at refineries on the Atlantic seaboard, being Code Authority prices, less delivery and interest charges of 0.225c. per lb. which is the average differential for delivery in New England.

(c) Export quotations for copper are net prices at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. The c.i.f. Hamburg, Havre, and Liverpool basis commands a premium of 0.300c. per lb. above our f.o.b. refinery quotation.

Excepting "Blue Eagle" copper, the above quotations are our appraisal of the major United States markets, based on sales reported by producers and agencies. All prices are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(d) Silver other than newly mined domestic. Under Executive order issued April 10, 1935, the U. S. Government price on newly mined domestic silver was established at 71.11c. per troy ounce; under order issued April 24, 1935, the Government's price was established at 77.57.

(e) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

April	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic Bid	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
1	30 7500	31.1250	34.0000	216.2500	212.5000	11.6250	11.8750	12.2500	12.5000
2	30.3125	30.75 0	33.5000	216.7500	213.5000	11.3125	11.6250	12.0000	12.3125
3	30.2500	30.6875	33.7500	217.5000	214.7500	11.6875	12.0000	12.1875	12.5000
4	31.0625	31.5000	34.5000	222.5000	219.5000	12.1250	12.3750	12.7500	13.0000
5	31.1875	31.6250	34.5000	223.0000	219.7500	12.2500	12.5000	13.0000	13.2500
8	31.7500	32.1250	35.2500	223.7500	219.5000	12.1875	12.3750	13.0000	13.2500
9	31.6875	32.1250	35.2500	224.5000	220.7500	12.0625	12.3125	12.8750	13.1250
10	31.5000	31.9375	35.0000	223.2500	219.7500	12.0625	12.3125	12.8125	13.0625
11	31.5625	31.9375	35.2500	225.2500	221.5000	12.1875	12.4375	12.8125	13.0625
12	31.6875	32.1250	35.5000	226.7500	224.0000	12.2500	12.5000	12.8125	13.0625
15	3 6250	32.0625	35.2500	226.2500	222.5000	12.3750	12.6250	12.8750	13.1250
16	31.3750	31.8125	35.0000	226.7500	223.0000	12.4375	12.6875	13.0625	13.3125
17	31.1875	31.6250	34.7500	225.7500	222.0000	12.5000	12.7500	13.1250	13.3750
18	31.3750	31.7500	35.0000	224.5000	221.0000	12.4375	12.6875	13.1250	13.3750
19					Holiday				
22					Holiday				
23	31.3750	31.7500	35.0000	224.7500	220.7500	12.4375	12.6250	13.2500	13.4375
24	31.1250	31.5625	34.7500	225.7500	221.7500	12.2500	12.4375	13.0625	13.3750
25	31.0000	31.4375	34.7500	224.7500	220.5000	12.2500	12.4375	13.0000	13.2500
26	31.3125	31.7500	34.7500	224.5000	220.3750	12.4375	12.6250	13.2500	13.3750
29	31.1250	31.5000	34.7500	223.0000	218.2500	12.6250	12.8125	13.1250	13.2500
30	31.3750	31.8125	34.7500	224.7500	219.5000	13.1250	13.1875	13.4375	13.5625
Av.for month	31.231	.....	34.763	223.513	.....	12.231	12.459	12.891	13.128

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(May 1, 1935)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb.	19@21c.
Antimony, domestic or Chinese (duty paid), lb.	14c.
Bismuth, ton lots, lb.	$1.10
Cadmium, lb.	65.00c.
Chromium, 97 per cent grade, lb.	88.00c
Nickel, electrolytic cathodes, lb.	35.00c.
Magnesium, 99.8 per cent, carloads, lb.	30.00c.
Palladium, troy oz.	$24.00
Platinum, (official quotation) troy oz.	$32.00
Quicksilver, flask of 76 lb. 100 flasks or more.	$72.50
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb.	$2.00
Silicon, minimum 97 per cent spot, lb.	16.50c.
Tellurium, lb.	$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$16.00@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent, Joplin, Mo., ton	$36.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52@55 per cent	26c.
49@51 per cent	25c.
44@47 per cent	24c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$16.00
Domestic Scheelite	$15.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$26.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	3½c.
Cobalt Oxide, 70@71 per cent, lb.	$1.35
Copper Sulphate, 100 lb.	$3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.24
Sodium Sulphate, bulk, ton.	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 3.5 per cent Be, per lb. of contained Be	$25.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent. gross ton.	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained.	95c.
Ferrosilicon, 50 per cent, gross ton.	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained.	$1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$500@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$45@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 95 per cent $BaSO_4$, less than 1 per cent iron	$5.50
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a)$4.50@ $6.00
French, 56@59 per cent	(a)$5.50@ $6.50
China Clay, f.o.b. mines ton:	
South Carolina and Georgia, bulk	$6.00@ $7.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton.	$13.00
Fuller's earth, f.o.b. Georgia or Florida, ton.	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2 in.	15@30c.
2x2 in.	30@50c.
2x3 in.	50@65c.
3x4 in.	90@ $1.25
4x6 in.	$1.50@ $2.50
White, ground, 70 mesh, ton.	$60.00@$80.00
Ocher, Georgia, ton.	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c.
Silica, water-floated, in bags, 325 mesh, ton.	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets gross ton	$27.00
Structural shapes, 100 lb.	$1.80
Bars, 100 lb.	$1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1934	1935	1934	1935	1934	1935
January	44.188	54.418	19.382	24.584	504.644	489.207
February	45.233	54.602	20.073	24.818	503.085	487.278
March	45.875	59.048	20.278	27.380	509.259	477.635
April	45.180	67.788	19.740	30.986	515.210	483.596
May	44.226	.....	19.276	.....	510.510	.....
June	45.173	.....	19.981	.....	504.721	.....
July	46.310	.....	20.512	.....	503.990	.....
August	48.986	.....	21.377	.....	506.398	.....
September	49.484	.....	21.888	.....	499.344	.....
October	52.375	.....	23.581	.....	494.019	.....
November	54.255	.....	24.257	.....	498.832	.....
December	54.390	.....	24.404	.....	494.520	.....
Year	47.973	.....	21.229	.....	503.711	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery			London Spot			
	Electrolytic			Standard		(a) Electrolytic	
	Domestic		Export				
	1934	1935	1935	1934	1935	1934	1935
January	7.890	8.775	6.583	32.560	28.077	35.614	31.261
February	7.777	8.775	6.341	33.072	27.175	35.969	30.244
March	7.775	8.775	6.526	32.497	28.518	35.512	31.607
April	8.173	8.775	7.328	33.006	31.231	36.038	34.763
May	8.275	.....	.....	32.662	.....	35.756	.....
June	8.594	.....	.....	32.149	.....	35.339	.....
July	8.775	.....	.....	29.707	.....	32.778	.....
August	8.775	.....	.....	28.358	.....	31.483	.....
September	8.775	.....	.....	27.541	.....	30.556	.....
October	8.775	.....	.....	26.753	.....	29.478	.....
November	8.775	.....	.....	27.233	.....	30.222	.....
December	8.775	.....	.....	27.836	.....	31.086	.....
Year	8.428	.....	.....	30.281	.....	33.319	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1934	1935	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.000	3.692	3.900	3.542	11.304	11.517	10.321	10.514
February	4.000	3.528	3.900	3.378	11.634	11.913	10.216	10.413
March	4.000	3.579	3.900	3.429	11.545	11.842	11.012	11.188
April	4.179	3.692	4.042	3.542	11.500	11.794	12.231	12.459
May	4.140	.....	3.990	.....	11.051	11.341	.....	.....
June	3.975	.....	3.825	.....	11.054	11.253	.....	.....
July	3.772	.....	3.623	.....	10.813	11.045	.....	.....
August	3.747	.....	3.597	.....	10.821	11.028	.....	.....
September	3.685	.....	3.535	.....	10.388	10.613	.....	.....
October	3.654	.....	3.504	.....	10.359	10.554	.....	.....
November	3.567	.....	3.417	.....	10.432	10.597	.....	.....
December	3.604	.....	3.454	.....	10.316	10.500	.....	.....
Year	3.860	.....	3.724	.....	10.935	11.166	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	Straits New York		Standard, Spot London	
	1934	1935	1934	1935
January	51.891	50.916	226.631	231.193
February	51.668	50.063	226.731	227.381
March	53.838	46.962	233.863	215.726
April	55.622	50.154	239.181	223.513
May	53.541	.....	234.239	.....
June	51.271	.....	226.875	.....
July	51.930	.....	230.381	.....
August	51.953	.....	228.114	.....
September	51.503	.....	229.888	.....
October	50.951	.....	230.587	.....
November	51.227	.....	228.602	.....
December	50.902	.....	228.178	.....
Year	52.191	.....	230.273	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.271	3.730	14.688	14.943	11.994	12.207
February	4.384	3.714	14.844	15.125	11.819	12.000
March	4.368	3.894	14.735	15.033	12.095	12.250
April	4.370	4.030	14.916	15.200	12.891	13.128
May	4.346	.....	14.722	14.966	.....	.....
June	4.240	.....	14.241	14.467	.....	.....
July	4.317	.....	13.466	13.693	.....	.....
August	4.281	.....	13.682	13.756	.....	.....
September	4.049	.....	12.644	12.847	.....	.....
October	3.832	.....	12.217	12.353	.....	.....
November	3.732	.....	12.000	12.281	.....	.....
December	3.711	.....	11.730	12.016	.....	.....
Year	4.158	.....	13.657	13.890	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1934	1935	(a) 1934	(b) 1935
January	55.000	55.000	23.300	20.000
February	55.000	55.000	23.300	20.000
March	55.000	58.462	23.300	20.000
April	55.000	65.000	23.300	20.000
May	55.000	.....	23.300	.....
June	55.000	.....	23.300	.....
July	55.000	.....	23.300	.....
August	55.000	.....	23.300	.....
September	55.000	.....	23.300	.....
October	55.000	.....	23.300	.....
November	55.000	.....	23.300	.....
December	55.000	.....	23.300	.....
Year	55.000	.....	23.300	.....

Aluminum in cents per pound. 99 per cent grade. (a) Based on Aluminum Company's quotation. (b) Open market price.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1934	1935	1934	1935	1934	1935
January	7.198	14.111	67.538	72.760	38.000	34.000
February	7.172	14.250	72.011	72.500	38.000	34.000
March	7.545	14.250	75.472	72.500	38.000	32.846
April	7.918	14.029	75.930	72.500	38.000	32.000
May	8.465	.....	75.577	.....	36.538	.....
June	7.900	.....	75.000	.....	36.000	.....
July	8.024	.....	75.000	.....	36.000	.....
August	8.514	.....	75.000	.....	36.000	.....
September	8.745	.....	74.563	.....	36.000	.....
October	9.361	.....	74.000	.....	35.038	.....
November	12.239	.....	73.283	.....	35.000	.....
December	13.730	.....	73.000	.....	35.000	.....
Year	8.901	.....	73.865	.....	36.465	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1934	1935	1934	1935	1934	1935
January	18.00	19.00	17.00	18.00	17.50	18.50
February	18.00	19.00	17.00	18.00	17.50	18.50
March	18.00	19.00	17.00	18.00	17.50	18.50
April	18.48	19.00	17.48	18.00	17.98	18.50
May	19.00	.....	18.00	.....	18.50	.....
June	19.00	.....	18.00	.....	18.50	.....
July	19.00	.....	18.00	.....	19.50	.....
August	19.00	.....	18.00	.....	18.50	.....
September	19.00	.....	18.00	.....	18.50	.....
October	19.00	.....	18.00	.....	18.50	.....
November	19.00	.....	18.00	.....	18.50	.....
December	19.00	.....	18.00	.....	18.50	.....
Year	18.707	.....	17.707	.....	18.207	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.

H. C. PARMELEE
Editorial Director

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A. W. FISHER
Manager

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WILLARD CHEVALIER
Vice-President

In August We Shall Publish a Colorado number of *E.&M.J.* Mining is active in the Centennial State and production is showing favorable gains in tonnage and profits. Recent geological work is pointing the way to new development. Due to splendid cooperation on the part of authors, we shall be able to present a picture of mining methods, milling practices, and geology of the San Juan, Cripple Creek, the Leadville area, and Boulder, Clear Creek and Gilpin counties. The oldest camps are experiencing revival as the result of high prices for gold and silver.

•

From Ore Flotation to washing clothes is a shorter step than it may seem, and this without covert reference to the famous anecdote of Mrs. Everson. An expert on the former has just testified in washing machine patent litigation. Operation of such equipment involves the separation of solids in the presence of oil and salts derived from the human body, and on the action of impellers; it turns, moreover, on the fact that an aqueous soap solution will wet a fiber better than an oil, and so cuts beneath the dirt and loosens it. Great is the importance of fundamentals.

•

Use of Thallium Salts in a depilatory once supplied a notorious case of resultant widespread skin poisoning—a reminiscence that leads a certain analyst to remark that this element is said to occur in appreciable amounts in the soil of the region that is the habitat of the Mexican hairless dog. Suggested relations are the effect of the presence of selenium in some submarginal farm lands, and of the lack of iodine in the soil of inland areas.

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The Government's Silver Purchase Program carried silver money stocks to the highest levels in history on April 30, according to the Treasury. Silver money stocks amounted to $1,150,654,563 of total money stocks of $14,678,503,278. Although total money in circulation declined slightly in April, silver in the hands of the public increased by $34,629,113, or more than a million dollars a day, to a total of $979,161,643. All of which may be of academic interest only as far as your pocketbook is concerned.

•

Quest of an Index for measuring the surface of a mineral powder has led A. J. Weinig, of the Colorado State Ore Testing Plant, at Golden, into a study of some interesting aspects of crushing and grinding, related to the type of reduction medium employed. An article covering this important research will appear next month. In it the author once more betrays his aptitude for mathematics.

•

Transmutation of a sort is evidenced in the recent metamorphosis of the Silver Queen into the Golden Queen in the Mohave region of southern California. Another change noted is the increase in the lure of mining in this area resulting from this discovery. New developments are promising. In the next issue, J. B. Huttl will describe what he saw on a recent visit.

•

Ten Little Niggers working in a mine. One was hit by falling rock, then there were nine. Which brings to mind that if NRA gets bumped off entirely, there will be only 53 other Government agencies left, all of which save three or four have been started in the last two years.

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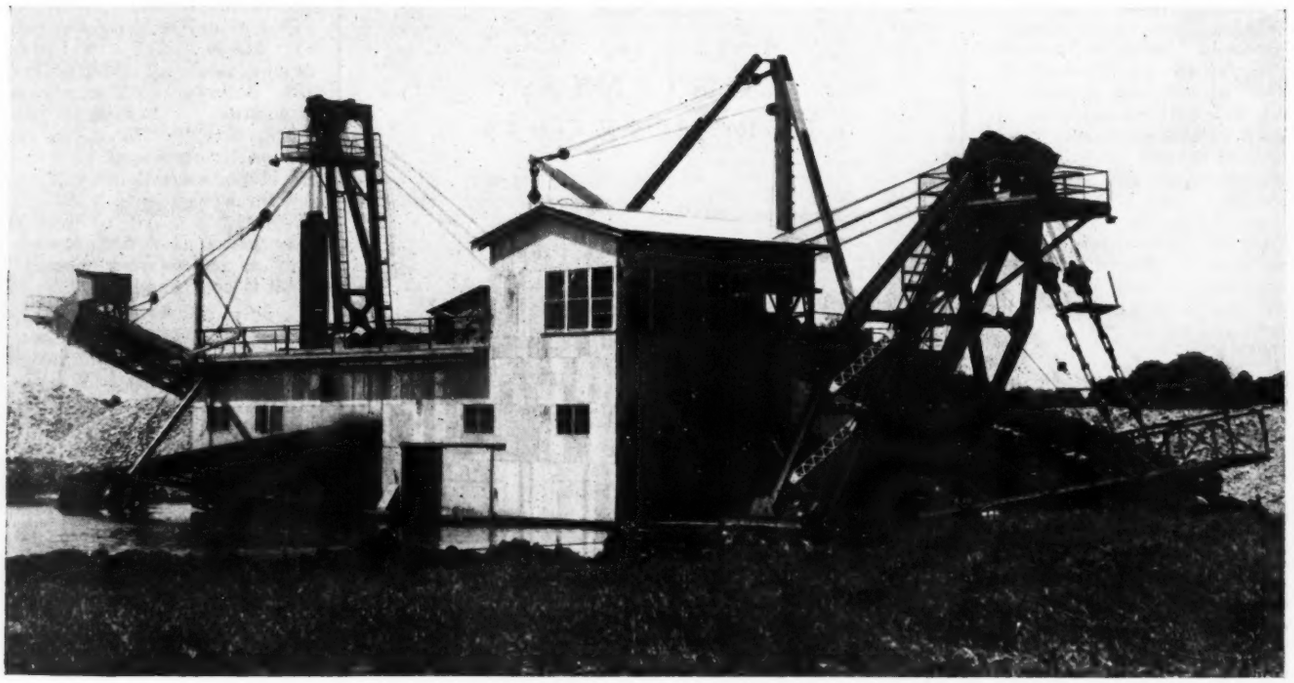

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